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Department of Psychology, College of Liberal Arts
Rochester Institute of Technology

Patient History Elicitation and Diagnostic Decision Making

by
Nicholas Iuliucci

A Thesis in
Experimental Psychology

Submitted in Partial Fulfillment of the Requirements for the Degree of
Master of Science

June 2, 2016

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Acknowledgements

My completion of this thesis was possible through the patient guidance of my adviser, Dr. Rantanen, the members of my thesis committee, professors Alm, Worrel, and Valentage, and the staff of the Department of Psychology at RIT. I would like to thank my family and friends for their support each day. Most of all thanks are due to my loving wife, who has acted as the cornerstone of the entire process.

Abstract

Technology has changed the way people communicate, and communication between patients and medical professionals has not been exempt from these developments. Clinicians are now text messaging, emailing, and video conferencing patient. Understanding the impact of the new modalities on communication patterns is imperative to ensure quality care. Thirty-two medical professionals of varying experience conducted a patient interview with two confederate patients over an instant messaging system. The first interview was 15 minutes and the second 7 minutes, the latter condition inducing time pressure. The results demonstrated that time pressure has an adverse impact on the medical professionals' communication patterns. The experience level of the medical professional was a mediating factor with strategies exhibited paralleling those outlined by stages of medical expertise.

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Introduction

A report by the Institute of Medicine (Institute of Medicine, 2000) estimated that 98,000 deaths were related to medical error each year in the US. This number is higher than deaths from motor vehicle accidents or breast cancer. In a recent study Makary and Daniel (2016) estimated that in 2013 medical errors caused 251,000 deaths in the U.S., making medical error the third leading cause of deaths in the U.S. after heart disease and cancer. Moreover, medical errors appear to be a global issue. In an analysis of 30,000 consultation records in an Australian hospital, 13.6% involved human errors that resulted in patient death (Brennan et al., 1991). Medical errors have received some attention from the media, but the problem persists. Errors related to misdiagnosis have been particularly understudied (Institute of Medicine, 2000; Schiff et al., 2005).

The lack of research into misdiagnosis is alarming, considering that an estimated 40,000 to 80,000 annual hospital deaths stem from diagnostic error. It is estimated that one of every six people experienced misdiagnosis (Schiff et al., 2005). In addition to a direct impact on patients, diagnostic errors can result in a financial cost to the hospital. Of malpractice claims from 1985 to 2000 (49,354 claims), 34% were related to diagnostic error (Phillips et al., 2004). Less severe consequences of misdiagnosis also have an impact on hospital resources since diagnostic errors can substantially extend a patient's stay at a hospital.

Medical mistakes that can cause a misdiagnosis fall into three broad categories: (1) knowledge, (2) communication, and (3) execution and judgment (Murphy & Dunn, 2010). Knowledge errors are gaps in the medical professional's education from on-the-job training and formal training in medical schools. Communication errors result from a physician's failure to gather and synthesize correct information, and failure to identify the incorrect information presented to them. Execution errors are deviations from set procedures that invalidate the results. Judgment errors relate to the medical professional's decision making or diagnostic approach.

Graber, Franklin, and Gordon (2005) deconstructed 100 cases of diagnostic errors of

internists through autopsies and other official reports to identify system and cognitive factors that attributed to an error in diagnosis. They uncovered 548 different systems and cognitive factors that contributed to the resulting medical errors. Out of these 548 factors 320 were identified as cognitive in nature. Within the steps to diagnose patients, cognitive errors occurred during the synthesis of information (159 instances), verification of data (106) and premature closure (39) of a medical case (Graber et al., 2005). Premature closure is when a medical professional stops considering alternative possibilities after reaching a diagnosis.

It is important to note in that on average 5.9 factors were identified in a single case in this study. The conclusion that multiple factors compound to create a medical error is not surprising since patient interviews are complex and require medical professionals to manage several aspects of the exchange at once.

The practice of medicine is presently undergoing fundamental changes due to the rapidly increasing availability of online and mobile technologies. According to research conducted by Parks Associates (2014), clinician-patient video interviews are likely to increase from 5.7 million in 2014 to over 16 million in 2015 and will exceed 130 million in 2018. With the ease of access, lower cost, reduction of geographic constraints, as well as clinician buy-in, more patients are finding video conferencing an appealing alternative for non-urgent medical care. Despite the potential growth in these numbers, little research has been conducted to ascertain the effectiveness of such videoconferences. With 31% of internet users 50+ using video conferencing (Smith, 2014) and the growth of medical needs with the aging population, it makes sense that a large percentage of the increase in clinician-patient video consultations will come from this population. While studies examining technology use frequently overlook the aging population (Cutler, 2005) in the field of telehealth this could be particularly problematic due to the uniqueness of this population and their technology experiences. Clearly, medical professionals must adapt to this new reality and both to the new opportunities and constraints brought about the emerging telehealth practices.

Patient Interviews

Patient interviews are, on average, 15 minutes long (Migongo et al., 2012). Patients arrive with basic information about the factors that instigated them to seek medical consultation. Nurses or administrative professionals gather demographic and fundamental information that is then delivered to the medical doctor or physician assistant (PA) to review and reference during the interview. Recently, PAs have increased in prominence as they cost less and can perform similar functions to a medical doctor (Roblin, Howard, Becker, Adams, & Roberts, 2004). They act as complementary medical workers to medical doctors, who supervise their work and provide the requested insurance. The expanded use of PAs has increased on a global scale over recent years (Hooker, Hogan, & Leeker, 2007). Usage of PAs within a medical organization has been shown to reduce operational cost by 20% while increasing patient safety and quality (Moote, Krsek, Kleinpell, & Todd, 2011). Regardless of the medical professional completing the interview, his or her role is the same, and henceforth a term “clinician” is used here to refer to any health care professional, including PAs, who work as a primary caregiver of a patient and is therefore likely to engage in clinical interviews.

During patient interviews, a clinician has three primary tasks to complete while communicating with the patient. The first is to facilitate communication to keep the patient engaged and elicit medically relevant information. Secondly, the clinician has to access their knowledge sourced from experience and training to identify pertinent information. Lastly, the clinician has to synthesize all the factors of the situation to decide on the diagnosis for the patient and communicate next steps.

Communication. The medical interview or consultation with the patient is a critical part of the patient-clinician relationship. The interview is an opportunity for both parties to share information and for the patient to become more than just a medical problem to be solved. Both verbal and non-verbal communication occurs within the interaction. The information gathered from the patient allows the clinician to view the patient within a unique context (Lypson, Page, Bernat, & Haftel, 2013). It is also important that a pa-

tient feels respected during the interview process (Lypson et al., 2013; Bickley & Szilagyi, 2012; Khalib & Farid, 2010). A medical interview goes beyond capturing just the medical information to accurately diagnose a patient and is supported by conventional techniques clinicians use during interactions with the patient.

Definitions of best practices in the interview technique vary for clinicians, but there are commonalities. Many articles on the appropriate interviewing technique emphasize the use of open questions to facilitate communication and then to use closed-ended/direct inquiries to clarify the information. (Lypson et al., 2013; Bickley & Szilagyi, 2012; Khalib & Farid, 2010; Lipkin, Quill, & Napodano, 1984). Open questions are inquiries that require the other person to give an explanation or description of the topic. While open questions are used to obtain a large amount of information from the patient, close-ended/direct questions are used to clarify particular information. Commonly a close-ended question requires only a yes or no from the patient. Direct questions can disrupt the flow of communication if incorrectly used. That is why clinicians are encouraged to use transitional statements.

Transitional statements involve summarizing the patient's response while linking the next topic which allows the clinician to keep information organized and direct the flow of communication (Lypson et al., 2013). During the conversation, it is important that the clinician pays attention to both the verbal and non-verbal cues that the patient provides during the interaction. When the patient provides personal information, such as a family or relationship problem, the interviewer should make sure to be sensitive to the topic, but also explore the area for potential influencing factors on health status (Lypson et al., 2013).

The patient should feel that the interaction is one of a partnership, which is clearly non-judgmental and encouraging in nature (Lypson et al., 2013). While the relationship may be a partnership, the clinician must maintain a professional image. Maintaining a professional image during the interview does not mean that the interview should use medical terms, but rather that it should explain all medical information in a language that is accessible for the patient to understand (Khalib & Farid, 2010). Recent literature has promoted the inclusion of the patient in the decision-making process, through interactive communi-

cation, such as diagrams and other visual aids (Khalib & Farid, 2010). Clinicians are also instructed to use silence as a means to encourage discussion and patient participation in the interaction (Bickley & Szilagyi, 2012). Many of the guidelines or suggested techniques support a patient-centered communication approach.

Medical education organizations vary in how they teach the approach to student. In an effort to align the field, a three-day conference was held in Kalamazoo, Michigan, in May 1999. Twenty-one representatives of prominent U.S. medical institutions and educational organizations discussed patient-centered communication (Brunett et al., 2001). Five models of patient centered communication along with teaching techniques were discussed in an effort to identified key commonalities between all the approaches. The result was 6 key elements: (1) open discussion, (2) gather information, (3) understand the patient's perspective, (4) share information, (5) research agreement on problem and plan, and (6) provide closure. The Kalamazoo consensus lay the foundation for assessment tools to be derived, which demonstrated consistent results (Duffy et al., 2004; Joyce, Steenbergh, & Scher, 2010). Patient-centered communication style has central concept that the interview process should involve a better understanding of the patient as an individual, be respectful throughout the process, and focus on both the biological and psychosocial aspects of the patient's illness (Lipkin et al., 1984; Boyle, Dwinnell, & Platt, 2005).

The patient-centered communication style has shown to improve interviewing skills in students who are exposed and instructed on the implementation of this methodology. (Boyle et al., 2005) implemented a patient-centered technique, which they refer to as "invite, listen, and summarize" (ILS). It is designed to achieve three core functions; (1) creating rapport, (2) collecting useful data, and (3) improving compliance. Boyle et al. (2005) conducted a three-year longitudinal study, which incorporated the ILS method into the curriculum at the University of Colorado School of Medicine. Students exposed to the ILS process improved interviewing skills, but whether the improvements persisted post-study is unknown.

Fallowfield, Jenkins, Farewell, and Solis-Trapala (2003) demonstrated in a study that after communication training clinicians showed improved communication skills that endured

into their clinical practice. Other studies have explored the impact that communication training can have in general on the interactions with the patient and outcomes related to patient health.

Yedidia et al. (2003) implemented communication training into the medical student curriculum at three U.S. medical institutions. All students in each of the schools were evaluated based on objective structured clinical examinations (OSCEs). OSCEs focused on five primary patient care aspects: (1) development and maintenance of relationships, (2) assessment, (3) education and counseling, (4) interactive medical decision making with patients, and (5) organizational time management. Yedidia et al. (2003) concluded that students exposed to communication training as part of their medical training intervention outperformed the non-intervention group in the OSCEs.

The impact of improved communication skills gains support from the research of Haskard Zolnieriek and DiMatteo (2009), who performed a meta-analysis of 106 correlational studies and 21 experimental interventions from 1949 to 2008 on the effect of communication skills on patient adherence to treatment. Poor communication has been linked to a 19% higher risk of patient's non-adherence in comparison to those who communicate proficiently (Haskard Zolnieriek & DiMatteo, 2009). When physicians had communication training, it was found to increase a patient's odds of adherence by 1.62 times more than that of physicians with no skill training (Haskard Zolnieriek & DiMatteo, 2009). Based on the findings of the previously mentioned studies, it is important for all medical programs to train their students in communication skills along with medical knowledge and to conduct more research on which factors impact communication. Uncertainty about the reliability of information elicited from patients is a factor that impacts communication and is closely tied to developing clinicians.

Uncertainty in patient history. Uncertainty of diagnostically relevant information obtained from the patient (mis- or dis-information from the patient), that can be linked to many causes, increases the difficulty of the diagnosis. Three primary root causes reduce the quality of patient-derived information during history elicitation: (1) comprehension,

(2) recall and (3) evaluation (or expression) (Redelmeier, Ferris, Tu, Hux, & Schull, 2001). Comprehension is related to how the patient presents the information verbally to the clinician, and how the patient interprets the clinician's questioning. Ambiguous language and misunderstandings are contributing factors to comprehension errors. Recall refers to mistakes in the patient's memories, or assumption that information is irrelevant and its removal from the recall. Evaluation, or expression, refers to the clinician's assessment of the information. Redelmeier et al. (2001) suggested that communication techniques and awareness of the root causes mentioned earlier will assist the clinician in reducing the uncertainty of patient history.

The reduction of uncertainty is vital, especially with developing clinicians, who commonly experience uncertainty (Farnan et al., 2010). In response to uncertainty, emerging professionals will attempt to avoid negative attributes of admitting uncertainty to the supervisor, and they will also seek informal assistance at the cost of delaying diagnosis or treatment (Farnan et al., 2010). Optimizing communication by reducing the impact of uncertainty is critical, as it is the channel that clinicians use to gain access to diagnostically relevant information. The optimization of clinical communication is made more difficult considering how long clinicians have to interview the patient.

The “Sacred Seven”. According to the “Sacred Seven” (S7) approach, each symptom has seven attributes that should be identified by clinicians. They are (1) location, (2) quality, (3) quantity, (4) timing, (5) environment, (6) influencing factors, and (7) associated manifestations (Bickley & Szilagyi, 2012). It is suggested that if, through the identification of each of the symptoms and the seven attributes, the cause is still unclear, the diagnostician should identify abnormal findings and locate them anatomically. Once located, the probable process should be interpreted in the diagnostic data set. Bickley and Szilagyi (2012) instructed clinicians to make one or more hypotheses that would fit all the symptoms. They also expressed the importance of weighing competing possibilities based on their similarity to the common representation of the competing diagnoses, along with the statistical probability, and the timing of the illness.

Diagnostic Decision-making

Five primary models of decision-making are relevant to the topic of clinical diagnosis: (1) classical, (2) heuristics and biases, (3) information processing, (4) dual processes, and (5) naturalistic. These are not the only models of decision making, but each has a strong research base supporting the theory, or the model.

Classical decision-making. Classical decision-making or normative approach to decision-making has origins in economics (Banning, 2008; Shaban, 2012; Simon, 1959). The normative approach focuses on the use of a methodical approach to problem solving, relying on statistical probability to guide the decision-making process to a logical and rational conclusion. Classical decision-making is idealistic in nature and assumes that all variables are clearly defined and known, which in most situations is *not* the case. Research grounded in classical decision-making commonly produces findings that are limited to theoretical and non-applied constructs. A resurgence was experienced with the advent of Bayes' theorem (Berger, 2013), which is also a normative model.

Bayes' theorem acknowledges variability allowing for application of statistical decision making in realistic environments (Hunink et al., 2014; David, Guyatt, & Tugwell, 1991; Bergus, Chapman, Gjerde, & Elstein, 1995). When applied, Bayes' theorem normalizes the constant to account for false positives. This is achieved by the hypothesized diagnosis probability of being correct (pre-test probability) as a function of the known prevalence of the disease, multiplied by strength of evidence. The result is divided by the likelihood ratio, which normalizes the result and accounts for false positives. Often the pre-test probability is subject to clinician's opinion of disease prevalence (Hunink et al., 2014; David et al., 1991). Bayes' theorem assumes that all evidence will be weighted by the clinician equally, but human judgement is subject to order effect, meaning recent evidence commonly is weighed greater than past evidence (Bergus et al., 1995). This approach theorem supports clinical education as a teaching tool for medical students check their assumptions (Elstein & Schwarz, 2002).

Heuristics and biases in decision making. Norman and Eva (2010) found that cognitive errors are the result of one or more cognitive biases. Cognitive biases are perceptual distortions of information which have been consistently displayed in human judgment and interactions. The impact of the biases such as premature closure, which has already been demonstrated to be a source of diagnostic error, can increase the likelihood of diagnostic error (Graber et al., 2005; Norman & Eva, 2010).

Some of the common biases related to diagnostic error are availability, base rate neglect, representativeness, and confirmation biases (Norman & Eva, 2010). The cognitive bias of availability refers to the diagnosis being derived from a recently encountered diagnosis that is easily retrieved from memory (Tversky & Kahneman, 1974). Base rate neglect is a cognitive bias where a diagnostician has overlooked the actual probability of the disease or medical issue, even when cases are rare (Tversky & Kahneman, 1974). When a clinician focuses on identifying the typical indication of a disease and misses a rare, but a pertinent symptom, they have exhibited a representativeness bias. Confirmation bias refers to the tendency to assess new information from a vantage point that supports an existing hypothesis, but research has shown that confirmation bias has become less frequent (Tversky & Kahneman, 1974; Graber et al., 2005).

Dual processes. The dual process theory of information processing identifies two types or styles of processing the incoming information (Kahneman, 2003; Croskerry, 2009). Type 1, or intuitive processing, is a heuristic-based associative approach to the information, which is related to skilled reflexive actions that are contextually dependent. Type 1 processing is associated with high automation and low cost, but it is susceptible to errors. However, little evidence supports this claim (Norman & Eva, 2010). Type 2, or analytical processing, is a deliberate deductive approach to information. Input information is reasoned against statistical knowledge, known rules, and formal structure to direct decisions. Properties such as high mental cost, few errors, and high predictive values results in longer deliberation before decisions can be selected using analytical processing.

Which information processing type is activated depends whether a pattern is rec-

ognized that relates to information from experience or causal knowledge network. When a pattern is recognized, intuitive processing can be activated, normally resulting in rapid action. Overconfidence in the accuracy of pattern recognition and activation of intuitive processing can lead to errors. While there are two information processing approaches, neither is solely used over the course of interaction. Individuals switch rapidly between both methods (Kahneman, 2003; Croskerry, 2009). Therefore, demonstrating an appropriate level of reliance on both systems would be necessary for an optimal speed–accuracy tradeoff.

Information processing approach to decision-making. Bayes' theorem advances the classical approach from a statistical angle, whereas information processing accounts for the accessibility of the correct probability as a function of long term memory (Wickens & Hollands, 2000; Malhotra, 1982; Simon & Newell, 1971). As the reader of this paper views written words, sensory information is placed into visual memory. To comprehend the clustering of information placed in working memory, once recognized and linked with related content, the information in long term memory is called for. The quality of the encoding affects the speed and ease of retrieval of the information. Factors that improve recall are frequency, recent similar information, and mental state at time of presentation (Schneider & Shiffrin, 1977; Malhotra, 1982; Bordage & Zacks, 1984). During patient interviews information elicited from the patient is recognized by the activation of memory based on similar or contextual cues. Diagnosis based on human memory is subject to error is encoding, recognition, and recall (Kassirer, Kopelman, & Wong, 1991; Bordage, 1999).

To perform their job efficiently the clinicians must be able to diagnose the problem correctly before they can treat their patients. The diagnosis is the result of a hypothesis, which they believe is well supported by the information gathered. The information used to support the diagnostic hypothesis can be referred to as “cues”, but not every clinician recognizes the same cues in the same situation. The variation in recognition could be a result of a different cue perception and skill sets.

For the diagnostic cue to be perceived, the clinician has to assign attentional resources to the task. There are constraining trends in human ability to estimate statistical informa-

tion of cues, in particular, proportion and variance. A clinician's knowledge of statistical likelihood aids them in selecting a hypothesis. Knowledge of the prevalence of a disease or symptom can direct the cue accumulation during the interview to support the most likely diagnosis. It is, therefore, imperative that the clinician has a correct perception of the statistical likelihood of a diagnosis explored. People can provide statistical estimations with high accuracy when the information presented is in the form of a mean; some humans display a perceptual bias in the processing of proportion and variance. Proportions are commonly distorted when they approach an extreme condition, producing inflated perception of the likelihood of a disease or illness. When a small likelihood or rare event does occur, the perception is artificially inflated, even though the proportion has not changed (Wickens & Hollands, 2000). Cues integrated into diagnostic reasoning are based on the calculated weight or relevance to hypothesized diagnosis.

Wickens and Hollands (2000) explained that the relation of a cue to the hypothesis should be identified by focusing on three essential properties (1) diagnosticity, (2) reliability or credibility, and (3) physical features of each cue elicited from the patient. Diagnosticity of a cue refers to the impact that the cue provides towards a hypothesis or an alternative hypothesis. Reliability or credibility of a cue refers to whether or not the cue is believable or not, which is independent of the diagnosticity of a cue. The physical features of a cue impact the attention given to the cue based on the degree of saliency that the features display toward a hypothesis. The two characteristics of a cue, Diagnosticity (D) and Reliability (R), are expressed on a scale from 0 to 1 and the product of the two represents the information value (V) of a cue, or $V = D \times R$ (Wickens & Hollands, 2000). This model of cue perception is grounded in a probabilistic approach. It is similar to the medical approach proposed by Bickley and Szilagyi (2012), which also states what information should be accumulated about each symptom.

As presented by Wickens and Hollands (2000), the perception of the statistical likelihood of symptoms and disease prevalence is susceptible to error, but known cognitive limitations can also influence the final diagnosis. If the information presented to the di-

agnostician is overwhelming, it can lead to cognitive overload and impact the effectiveness of the diagnostic process. It has also been found that many times the processed cues are not differentially weighed; instead, cues are perceived as having equal importance in the diagnosis (Wickens & Hollands, 2000). There is a need for research into how clinicians can reduce the influence of cognitive and perceptual limitations and how time restraints affect such limitations.

Naturalistic decision-making. The naturalistic decision-making, or intuitive-humanist, approach, focuses on the roles of intuition and experience in the decision process when problems are not clearly defined (Banning, 2008; Shaban, 2012). Intuition in the intuitive-humanist model focuses on pattern recognition that activates when triggered by experience-based knowledge networks of similar events. False triggering of pattern recognition based errors in memory can cause wrong decisions and is a limitation. Experience is relied on by the individual to guide decisions (Banning, 2008). Research grounded in naturalistic decision-making lacks generality, since cause and effect are not identifiable in complex and naturalistic settings that characterize the research paradigm.

Klein (1993) proposed the Recognition Prime Decision (RPD) model, which focused on how experience, situation awareness, and mental simulations enhance decision making. The RPD model is different from classical decision-making paradigms, and it explains how decisions are made in ill-defined or time-pressure situations. The RPD model acknowledges that both analytical and intuitive processing occurs simultaneously, but argue that intuition be driving the process. Klein (1993) identified that decision makers, such as clinicians, would recognize a pattern of cues which then would be matched to a single hypothesis or action script. The hypothesis is validated by mean of mental simulation. Accuracy and structure of the simulations are based on experience. The hypothesis is altered or rejected based on mental simulation and new external cues. If rejected, the decision maker will start the processes again.

The Role of Experience and Expertise in Diagnostic Decision-Making

Benner (1982) identified and separated the development of clinicians into five different categories: (1) novice, (2) advanced beginner, (3) competent, (4) proficient, and (5) expert. Novices have an academic understanding of the fundamental parameters of the patient's condition but lack the ability to make judgments and decisions based on the information. The lack of confidence in their action is derived from a lack of experience. Novices demonstrate reliance on linear thinking and maintain a confirmation cue seeking behavior (Schubert, Denmark, Crandall, Grome, & Pappas, 2013). Advanced beginners have integrated guidelines and rules for how to internalize the information presented to them but lack the ability to differentiate clinical cue relevance. Competent clinicians begin to comprehend the cause and effect of their actions on the long-term care and treatment of patients. Once clinicians have developed a holistic understanding of their actions and start to comprehend the impact of the differential cue on the value of the situation, they have shifted into proficient stage of development. The final expert stage of development is characterized by an ability to access an expansive network of information rapidly, to the point that identifying a correct decision seems natural. Based on the developmental state of the individual, the impact of time pressure on how they interact with a patient as well as their ability to identify relevant clinical cues will vary drastically.

The transition of clinicians from a basic rule-based understanding of patient condition to a rapid holistic understanding demonstrates a shift toward intuitive processing of information (King & Clark, 2002). The role of intuition changes during a clinician's development towards expertise (King & Clark, 2002). Surgical ward and intensive care nurses were observed and interviewed by King and Clark (2002) to explore the relationship between intuition and expertise. The 61 participating nurses were classified into four distinct groups; advanced beginner nurses, competent, proficient, and expert nurses. The groups were previously identified by Benner (1982).

Advanced beginners were able to make a simple decision based on the vitals, but were unable to handle situations beyond their experience and theoretical knowledge. Advanced

beginner nurses also missed non-overt cues to patient medical conditions. Competent nurses were able to handle more complex medical situations. The competent nurses demonstrated greater comprehension of theoretical knowledge, but the information had been integrated with past postoperative episodes. Proficient nurses demonstrated proficiency in rapid assessment of patients based on an identification of the non-verbal, verbal and physiological cues of patients. Proficient nurses were also able to assess rapidly patient conditions because they recognized the significance of subtle negative and clinical signs. Expert nurses displayed confidence and proficiency in their clinical decisions. The confidence was derived from past patient experiences to link intuitive feeling to a confident action, based on the support of past "intuitive" feelings. As expertise develops, the reliance on intuitive decision-making increases with the integration facilitated by past experiences. Thus proficient accurate diagnosis is the related cohesion of medical knowledge and field experience.

The evolution of expertise of the surgical ward and intensive care nurses from the study by King and Clark (2002) can be further explained by applying the transitory stages proposed by Schmidt and Rikers (2007). Based on a literature review of knowledge encapsulation and illness script hypothesis, Schmidt and Rikers (2007) separated clinical expertise development into four stages. The first stage involves the creation and expansion of causal networks, which are information rich connections developed around underlying biological or pathophysiological processes.

The inability of advanced beginner nurses to handle complex medical decision-making is a result of their limited causal networks (King & Clark, 2002). Nurses will then demonstrate a further expansion of causal networks, but also the integration of past experiences into their networks, based on a self-reflection of the episode, which improves diagnosis performance (Chamberland et al., 2011). The past experiences are used to encapsulate the information to simplify the information or provide diagnostic labels. The simplification of these rich information networks allows the individual to access and identify rapidly potential diagnostic conclusions (Woods, Howey, Brooks, & Norman, 2006).

The impact of experience can be seen even when comparing experts to other experts.

Of 21 experienced general practitioners (GPs), only 6 correctly diagnosed the patient with significantly less clinical information (Groves, O'Rourke, & Alexander, 2003). These individuals demonstrated a significantly smaller amount of interpretation errors of clinically relevant information. It is interesting to note that despite the better performance on the task, these 6 GPs scored lower than their colleagues on diagnostic evaluation tests. The difference between the 6 GPs and their colleagues likely is the result of differences in decision making.

Time Pressure

General practitioners have an average consultation length of 14.5 minutes (Migongo et al., 2012). Based on 1,522 patient visits to primary care clinicians who completed a modified version of the 1997–1998 National Ambulatory Medical Care Survey, a regression tree and a linear mixed model (LMM) were used to identify predictive variables for consultation length, 22 factors were identified. The LMM developed could only account for 38% of the variance in consultation length, however. Therefore other predictors need to be investigated. Time pressure has also been linked with influencing the quality of care received (Whiting et al., 2007), further emphasizing the importance of this factor on medical interviews.

Clinicians strive to base decisions in probability and systematic assessment of patient condition. Time pressure has been shown to be the primary inhibiting factor to adherence to such methodology (McKenna, Ashton, & Keeney, 2004; McColl, Smith, White, & Field, 1998). For example, Tsiga, Panagopoulou, Sevdalis, Montgomery, and Benos (2013) investigated the influence of time pressure on adherence to guidelines in primary care. Thirty-four general practitioners from Greece were presented patient information as it would be elicited during a consultation and they asked what would be the follow-up questions based on the new knowledge or next steps. Patient information was presented in four stages; (1) presenting complaint, (2) past medical history, (3) clinical examination and (4) laboratory test results. The same disease was used for both time pressure and non-time pressure conditions; each presentation was kept distinct from one another at all stages. Responses from

the participants were evaluated by two independent experts based on the national medical guidelines. The outcome of the study showed that when experiencing time pressure participants asked significantly fewer questions concerning presentation of symptoms and overall conducted a less thorough clinical examination. Time pressure condition exhibited fewer recommendations on lifestyle. However, the accuracy of participants' diagnoses did not decrease when placed under time pressure.

Research has shown that time pressure can affect the communication pattern of a clinician during a consultation, but a clear distinction between effective styles compared to ineffective styles can reduce the negative impact (Mauksch, Dugdale, Dodson, & Epstein, 2008). Effective communication style in a time pressure situation is defined by Mauksch et al. (2008) as a transparency of agendas between patient and physician. A physician with effective communication style limits rapport building, focusing instead on a few problems while remaining reflective about the patient's issues and integrating them into the process. In contrast, ineffective communication involves a highly structured interview that has no transparency and no integration of the patient to the process. Physicians displaying ineffective style of communication under time pressure become disease-focused and non-reflective. Physicians demonstrating an effective style of communication will maintain an open communication pattern with patients. Therefore, effective communication can be characterized by patient involvement and adaptive questioning pattern that maximizes the likelihood of eliciting clinically relevant cues, reducing uncertainty.

Uncertainty derived from fear of missed clinical cues and procedural errors are the main source of mental strain for a medical student (Nevalainen, Mantyranta, & Pitkala, 2010). Based on interviews and reflective diaries from 22 medical students, fear of error was identified as the main source of mental strain. While (Nevalainen et al., 2010) support the use of reflective writing as a means to express and deal with uncertainty among medical students, methods of assessing uncertainty within the diagnostic process should also be investigated. The expression of uncertainty, regardless of experience level, erodes the confidence of the patient in the clinician's ability (Ogden et al., 2002). Clinicians are aware

that displaying lack of confidence can cause a loss of patient confidence but the degree is greater than they anticipate (Ogden et al., 2002). A majority of the research designed to investigate expressions of uncertainty frequently focus on phrases to as identifiers such as “let’s see what happens” or asking the nurse for their opinion. Recent research focus onto the relationship between uncertainty in linguistic expression and diagnostic accuracy has showing alternative method (McCoy et al., 2012).

In yet another study, clinicians (dermatologists) were asked to speak out loud their thoughts and observations in a monolog in reaction to 50 images of dermatological conditions (Li, Pelz, Shi, & Haake, 2012). Acoustic-prosodic and lexical-structural linguistic features from the resulting transcript were used as identifiers of uncertainty in diagnosis (Hochberg, Alm, Rantanen, DeLong, & Haake, 2014). Acoustic-prosodic features included silence duration, total duration, and measures of pitch and intensity. Lexical-structural features include the number of words, disfluencies, nouns, and adjectives. Results demonstrated that acoustic-prosodic features yielded a higher accuracy than both combined. This result was argued to be related to the acoustic-prosodic features being averages of items across the entire narrative (Hochberg et al., 2014). Analysis of linguistic patterns, including acoustic-prosodic features, may represent a method to assess diagnostic patterns.

Purpose of the Research

This research introduced a novel approach to the study of clinician-patient interactions by integrating metrics from communication and linguistics to analyze clinician interaction data and decision making. While there is some precedence in analyzing consultations with linguistic considerations, prior work, such as that discussed by Harvey and Koteyko (2012), tends to have been qualitative in nature. In contrast, this research used linguistic features to engage with data-driven statistical and corpus-based analysis relevant to the topic at hand.

Premises

The review of the relevant literature allowed for identification of the following premises for this research:

Premise 1: Diagnostic errors are the result of multiple factors, commonly related to the elicitations of information, identification of relevant medical information and judgment. Research into doctor-patient communication should focus on the covariance of the factors that generate errors.

Premise 2: Patient-centered communication is accepted as the best practice for approaching communication during clinical interviews. Uncertainty is a detrimental factor to patient-centered communication and the methods to should be investigated at the early stages of professional development where uncertainty has the greatest prominence.

Premise 3: Clinicians are under pressure to utilize time efficiently. A clinician who effectively utilizes time demonstrates a communication style associated with patient-centered communication. Time pressure holds potential to act as a catalyst to highlight the usage of effective communication patterns.

Premise 4: Formal education encourages a structured method to identify relevant cues, yet weight given to the cues is influenced by individual perception of value. Experience has a mediating factor but does not consistently relate to technique encouraged by formal education. Cue seeking and identification are guided by formal education but shifts with experience.

Premise 5: Dual process theory acknowledges the reliance on formal and pattern recognition methods to integrate information into decision making. Heuristics and biases are distinct cognitive errors that impact various stages patient interview. Examinations of diagnostic decision making leveraging dual processing theory and heuristic and biases benefit from visibility into integration of information and the impact on the final decision.

Hypotheses

Specifically, this research tested the following hypothesis: *Under time pressure clinicians will adopt an effective style of communication, characterized by patient involvement and adaptive questioning pattern and manifested in an increase of open ended questions, percent of the S7 queried, agenda setting statements, mean latency and decrease in personal connection statements, medical terminology and queries with a high mean latency.*

Effective communication is characterized by patient centered communication and targeted collection of medically relevant cues. Patient centered communication leverages open ended questions and personal connection with patients along with transparency of agenda to maximize time usage during the conversation. This is shown to be effective at improving the outcome of patient consultations (Boyle et al., 2005; Fallowfield et al., 2003; Haskard Zolnierik & DiMatteo, 2009; Yedidia et al., 2003). Open-ended questions allow the clinician to elicit a rich amount of information with a single inquiry (Lypson et al., 2013; Bickley & Szilagyi, 2012; Khalib & Farid, 2010; Lipkin et al., 1984). By being transparent about the agenda, the patient understands their role, reducing the amount of time to transition between questions and topics (Mauksch et al., 2008). Personal connections allow the patient to feel open and understood by the clinician (Bickley & Szilagyi, 2012; Khalib & Farid, 2010). Eliciting the right information is critical to eliminating oppositional diagnoses and confirming the hypothesized condition. Training of clinicians would anticipate that they focus on the “Sacred Seven” and then shift to review of systems, but in a limited capacity (Bickley & Szilagyi, 2012). Medical education encourages the use of probabilistic reasoning (Bickley & Szilagyi, 2012; Wickens & Hollands, 2000), portrayed by the high diagnostic relevance cues asked first. This will reduce the number of subsequent questions to allow for the clinician to reach a diagnosis (Tsiga et al., 2013). As clinicians gain experience their ability to leverage probabilistic reasoning improves (Benner, 1982; Chamberland et al., 2011; King & Clark, 2002; Schubert et al., 2013).

Method

This research employed a novel experimental paradigm where clinical consultations were done via an instant messaging system. Moreover, our experimental setting allows for results to generalize to virtual doctor visits and video phone interviews that already are common (but under-researched) and that are expected to become the norm in near future. Mobile technology is also allowing the developing world to bypass much infrastructure existing in industrialized nations as they modernize. Virtual provider visits are therefore likely to form the majority of provider-patient interactions in the future, further emphasizing the importance of verbal communication between patients and providers.

Participants

A total of 32 students and alumni from the Physician Assistant (PA) program at Rochester Institute of Technology (RIT) participated, 24 females and 8 males. Their median age was 23.91 years ($SD = 5.9$). Of the 32 participants, 44% had medical experience prior to enrolling in PA program (such as an EMT) and 69% had finished, or were in the process of finishing clinical rotations as part of their program. Each participant was provided monetary compensation for their participation in the study.

Apparatus

The interlocutors interacted with each other via a chat terminal (AOL instant messenger or AIM). The advantage of using this modality for data gathering was that we could control the experiment and isolate the communicative potential of the verbal content and discourse patterns from other communicative parameters (such as facial expressions, gestures, posture, voice inflection, etc.).

Materials

Two patient scripts were written and developed by a PA instructor to create medically accurate fictitious patients, “Elliot” with diabetes and “Mary” with diverticulitis (see

Table 1.

Information Given to Participants (Patients' "Charts").

	"Elliot Hu"	"Mary Hoddack"
Age	31 years	63 years
Ethnicity	Asian-American	African-American
Height	5'6"	5'3"
Weight	220 lbs	142 lbs
Body Temp.	36.2°C	37.0°C
Blood Pressure	146/90	146/90
Pulse Rate	90/min	90/min
Resp. Rate	16/min	18/min
Chief Complaint	Patient complains of unusual frequent urination, estimated at 7 to 8 times a day	Patient has been experiencing left lower quadrate abdominal pain over the past 4 days

Table 1 and Appendices C and D). Diverticulitis occurs when matter gets caught in the pockets in the wall of the intestine. These pockets are the result of weak intestine lining caused by poor dietary habits. The matter in the pockets becomes inflamed and manifest as severe abdominal pain. The cases were designed to be of equal diagnostic difficulty.

To eliminate confounding non-verbal cues, such as body language or eye contact, patient interviews were conducted over an online messaging system (AOL instant messenger or AIM). Additionally, conducting the interviews virtually allowed for all three individuals (the participant, the confederate, and the moderator) required for the study design to be in different locations. Instructions for both the PA-participants and the confederate "patient" were developed to supplement email instructions (see Appendices E and F). The

moderator followed a pre-determined script (see Appendix E). To simulate a normal medical visit, preliminary information about both patients were developed (see Table 1). A pre-test questionnaire was used to gather demographic data (see Appendix G), and two post-interview questionnaires were administered to gather information on prior disease-specific knowledge and the participants' differential diagnosis (see Appendix H and I).

The demographic questionnaire focused on education and experience. Medical knowledge from jobs related to the field and exposure to a close relative in the medical field were identified to assess clinical knowledge prior to formal education. All participants were or had been students in RIT's PA program. Variance in academic experience was accounted through questions that recorded the following: (1) year in the program or alumni status, (2) clinical rotation experience and (3) amount of one-on-one interactions with patients. Alumni were requested to provide a number of years since graduation and specialty.

Independent Variable

This was a within-subjects design. The independent variable was the time available to make a diagnosis (15 minutes and 7 minutes). Because of a within-subjects design, different "patients" (one with diabetes, the other with diverticulitis) were presented at the different time conditions. The "patients" as well as the times to interview each "patient" were counterbalanced. The 7-min. consultation length was half of the common time with patients in professional settings to induce time pressure.

Dependent Variables

The dependent variables were a combination of four types; the communication technique, clinical approach, conversation and lexical structure. The following sections describe these variables (a shorthand label used later in the tables in the results section in parentheses) and how they were recorded. All numbers were counted from the entire 15- or 7-minute exchange between the participant-clinician (PA student) and the confederate "patient". For all 7-minute interviews, variables that represented counts were normalized by multiplying

them by two, allowing for direct comparison of frequencies of different elements between the time conditions.

Conversation structure. These variables pertain to the general structure of the discourse in the simulated clinical interview setting. Patient-centered communication relies on the clinician allowing the patient to become a partner in their exchange and not exhibiting unconstructive dominance (Brunett et al., 2001). Identification of the cause of the patient's medical concern is the clinician's primary task during the discourse. Clinicians are encouraged to leverage a variety of question formats (open-ended, deepening and compound) to explore the patient's symptoms (Lypson et al., 2013; Bickley & Szilagyi, 2012; Khalib & Farid, 2010; Lipkin et al., 1984). The breaks or pauses between statements can be leveraged to expose the degree of reflection (Kahneman, 2003; Croskerry, 2009; McCoy et al., 2012).

1. Percent correct diagnosis: Correctness of diagnosis (Boolean, 0 = incorrect, 1 = correct)
2. Number of given symptoms (No. Given): Participants were given symptoms within chief complaint; they did not need to ask about these in the interview.
3. Number of total lines (No. Lines): Total number of text entries (both parties).
4. Proportion of participant communications (PA proportion): Number of participant entered lines divided by the number of total lines.
5. Proportion of patient communications (Patient proportion): Number of patient entered lines divided by the number of total lines.
6. Number of consecutive turns (No. Conseq. Turns): Total number of compound questions.
7. Latency: Time (measured in seconds) between statements, or time between the patient's response and clinician's next question, or patient's question and clinician's response.

8. Information request (No. Info. Req.): Number of queries from the participant to elicit information from the patient.
9. Opening questions (No. Open. Questions): Number of questions that contain who, what, when, where, why, and/or require more than a singular response.
10. Number of compound question (No. Comp. Questions): The number of multiple questions within a single turn.
11. Number of deepening questions (No. Deep. Questions): The number of questions that follow the same topic than the prior statement (by either party) and seeks refinement of information.

Clinical. These variables pertain to the clinical information elicited, on which the decision about diagnosis will be based at the end of the interview. The first seven (12–18) correspond to the “Sacred Seven” attributes clinicians are trained to query about every symptom presented. Medical training programs are designed to provide clinicians with the knowledge and tools to have productive exchanges with patients (Bickley & Szilagyi, 2012). Diagnostic accuracy of clinicians does not consistently align with medical education assessment performance, however (Groves et al., 2003).

12. Query about the symptom location (Symptom Location): Whether the location of symptom source was queried (Yes/No), for example, where is it? Does it radiate?
13. Query about the symptom quality (Symptom Quality): Whether the character of symptom related to visual appearance, size, and descriptive categorizations was queried (Yes/No), for example, what is it like?
14. Query about the symptom severity (Symptom Severity): Whether the intensity or length of the symptom was queried (Yes/No), for example, how bad is it?
15. Query about the symptom onset (Symptom Onset): Whether the start of the symptom or when it was first noticed was queried (Yes/No), for example, when did it start?

How long does it last? How often does it come?

16. Query about the symptom Setting (Symptom Setting): Whether the environmental factors, personal activities, emotional reactions, or other circumstances that may have contributed to the illness were queried (Yes/No).
17. Query about the alleviating and aggregating factors (Symptom AA): Whether the factors targeted to identification of the actions or events that aggravate the symptom were queried (Yes/No), for example, is there anything that makes it better or worse?
18. Query about the associated manifestations (Symptom Ass. Manif.): Whether related symptoms were queried (Yes/No), for example, have you noticed anything else that accompanies the symptom?
19. Number of “Sacred Seven” elicited (% Sacred 7): The number of sacred seven elected during conversation (SE) divided by total number of sacred seven (TS)
20. Number of review of systems (ROS) queries (No. ROS): A list of questions that are leveraged once the “Sacred Seven” have been exhausted to expose related organ systems.
21. Percent of ROS queries (% ROS): The number of ROS related cues elicited during conversation (ROSe) divided by a total number of ROS related to organ system (ROSt).

Communication Technique. The following several variables measured the participants’ communication techniques to build rapport with the patients and elicit pertinent medical information from them. Patient-centered communication (PCC) is the accepted best practice for clinical interviews. The structure of the communication has a consistent central structure displayed by PCC (Brunett et al., 2001). The clinician must speak to patient in a manner that is easy to understand and foster a supportive relationship (Lypson et al., 2013; Bickley & Szilagyi, 2012; Khalib & Farid, 2010).

22. Percent of opening statements (% Opening Statements): Number of opening speech acts given context (introduction, greeting) divided by the total number of speech acts.
23. Percent of queries about complaints (%Complaint Queries): Number of speech acts aimed at identification of clarification of chief complaint divided by the total number of speech acts.
24. Percent of queries about context (% Context Queries): Number of questions or information request regarding information not directly related to chief complaint divided by the total number of speech acts.
25. Percent of diagnostic queries (% Diagnosis Queries): Number of admission or proposal for possible cause for chief complaint divided by the total number of speech acts.
26. Percent of treatment suggestions (% Treatment Suggestions): Number of suggestions for treatment or course of action to address chief complaint divided by the total number of speech acts.
27. Percent closing statements (% Closing Statements): Number of speech acts signifying termination of conversation divided by the total number of speech acts.
28. Percent acknowledgements (% Acknowledgments): Number of statements that reflect understanding to the next or following subsequent turns to the previous statement.
29. Percent agenda setting statements (% Agenda Setting): In clinician turns, number of statements indicating openness to setting agenda divided by the total number of speech acts.
30. Percent of personal connection statements (% Pers. Conn.): In clinician turns, number of statements making personal connection (focus is building rapport as compared to collecting information for diagnosis) divided by divided by the total number of clinician's speech acts.

31. Number of rare medical terms (No. Rare Terms): Number of rare vocabulary words and specialized medical terminology based on the Unified Medical Language System's (UMLS) Metathesaurus (<http://www.nlm.nih.gov/research/umls/>).
32. Number of summary statements (No. Summary Statements): The total number of responses that recounts multiple topics from previous responses in a single response.
33. Percent of first person pronouns (% First Person): Number of first person pronouns divided by the total number of pronouns.

Lexical Structure. The final set of variables were used to examine the lexical structure of the clinical interview. The dominance or uncertainty shown by the clinician is reflected in the structural nuances of their statements (McCoy et al., 2012).

34. Number of words in turn (No. Words in Turn): Number of words in each turn (or entry).
35. Number of elliptical (No. Elliptical Turns): Number of entries consisting of less than three tokens.
36. Number of long turns (No. Long Turns): Number of entries consisting of more than 15 tokens.
37. Number of coordinating conjunctions (No. Coord. Conj.): Number of conjunctions, that is, joiners, words that connect (conjoin) parts of a sentence. Among the coordinating conjunctions, the most common are *and*, *but*, and *or*.
38. Number of interjections (No. Interjections): Number of short utterances that usually express emotion and are capable of standing alone. Interjections are considered one of the traditional parts of speech.
39. Number of abbreviations (No. Abbreviations): Number of words or phrases that were typed in a shortened form.

40. Number of hedges (No. Hedges): Number of mitigating words or sounds used to lessen the impact of an utterance. Typically, they are adjectives or adverbs, but can also consist of clauses. It could be regarded as a form of euphemism.
41. Number of evidentials (No. Evidentials): Number of terms for the ways in which a speaker qualifies a statement by referring to the source of the information
42. Number of idiosyncratic sentences (No. Idiosyncracies): Number of incorrect or incomplete sentence structures.
43. Number of idiosyncratic spelling (No. Idiosyncr. Spell.): Number of incorrect or unusual spellings of individual words.

“Sacred 7” Ratings. Each symptom has seven attributes that should be identified by clinicians. They are; location, quality, quantity, timing, environment, influencing factors and associated manifestations (Bickley & Szilagyi, 2012). RIT PA students are instructed to elicit the seven attributes of a symptom each time they consult with a patient. For each consultation, the percent of sacred seven was computed;

$$\frac{\text{Attributes Elicited} + \text{Attributes Given}}{7} = \% \text{Sacred} \quad (1)$$

The number of attributes elicited is reduced by those given in the chief complaint documentation. The resulting number is divided by the total possible to compute the percent of sacred seven elicited during the session.

Review of systems ratings. Review of systems (ROS) is the list of questions focused on the physiological region related to the chief complaint by the patient. For example, if a patient exhibits pain in their abdominal region the medical profession would query the patient about the small/large intestine, stomach, and stool. For each interview, the percent of total ROS related cues was calculated:

$$\frac{\text{Elicited ROS}}{\text{Total ROS}} = \% \text{ROS} \quad (2)$$

The diseases that the Confederate patients exhibit are related to different systems of the body. The patient with diabetes presented to each PA with a chief complaint of increased urination associated with the genitourinary system. The patient with diverticulitis has stomach pain, which is associated with the digestive system. Each system has a list of related topics that PA are encouraged to investigate.

Procedure

Once recruited and scheduled, participants were sent instructions including step by step download instructions for AIM, login information to the account, and contact information. After logging on, participants contacted the moderator, who instructed them to complete a pre-test survey via a Google document link. Participants were then provided with the first patient chief complaint as if a nurse had already completed initial conversation.

They were told to initiate conversation via AIM with the first patient and that they will have 15 (or 7) minutes for this patient interview. The confederate, upon receiving the message, started timing the session. At 10 (or 5) minutes the confederate notified the participant that they had 5 (or 2) minutes left in the interview. Once 15 (or 7) minutes arrived, the confederate notified the participant that time has ended and they need to contact the moderator for the next instruction.

After that, they were given the link to the first post-interview survey (Appendix H). They were then provided with the second patient chief complaint and told to initiate conversation via AIM with the next patient. Following the second interview, they were given the link to the second post-interview survey (Appendix I). Once finished, the participant was thanked for their assistance and debriefed for the purpose of the study. In all, testing sessions lasted between 45 and 60 minutes.

Based on the collected written transcripts, theory-driven linguistic features were extracted and integrated into statistical analysis. The linguistic features were extracted from turns of the participants in the interactions, and then used in statistical analysis to answer specific research questions. For example, the features may verbally encode uncertainty on

behalf of the decision maker or interaction problems stemming from a poor consultation interview procedure, clinician overconfidence, unnecessary content complexity that confuses the patient, or the use of clinician-centered (as opposed to patient-centered) interaction patterns. The confederate patients were also recorded and considered, for they may reveal or trigger erroneous clinical decision-making.

Results

The resulting data consisted of written transcripts, each of which contained the interview interaction between a clinician-in-training (PA student) and a confederate patient with time stamps. The confederate patient was working off a script and had been provided with sample answers. Different constraints and manipulations were systematically imposed on the interactions to assess their impact.

The novel interaction paradigm of the study has to be validated to ensure that two criteria have been met; (1) disease difference exhibited by the confederate patient, and (2) time pressure influenced communication patterns of participants. Paired t-tests were run to explore the interactions disease and time manipulation had on participants' exchange with patients.

All t-test were run using the R statistical program. R Studio was used to consolidate the console and simplify the organization of screens. Two excel files were imported into R Studio. These excel files were organized so that variables organized by disease (Diabetes and Diverticulitis) and the other copy of the file by time (15 and 7 minutes). All count variables had been normalized by multiplying by two. Once uploaded into R-Studio, the excel file organized by disease was attached to the command file. The command used to execute the t-test was

```
t-test(Variable Name, Div_Variable Name, paired=TRUE)
```

After denoting the outcome, the variable name was replaced with the next variable naming convention. This procedure was repeated till all variables had been processed. Once all variables were executed for the t-test, the time disease file was attached to the command file. The same procedure for the disease was repeated for the time excel variables.

Disease

Eight of the 43 dependent variables tracked for the sessions demonstrated an influence based on disease (See Table 3). Four clinical cue seeking related variables were

identified as being influenced by disease of the patient. Percent of the “Sacred Seven” attributes elicited during diabetic disease condition was significantly lower, by nearly 29%, than that of the diverticulitis case. Examination of the underlying variables that attribute to the “Sacred Seven” percent suggests that queries regarding location, setting and alleviating/aggravating factors of the chief complaint were primarily responsible for this difference. Queries regarding the symptom location were significantly less likely, by nearly 69%, for diabetes than for diverticulitis.

Table 2.

Conversation Structure; Measures, Means (SD), and Difference Between Means, with t-test Results.

Measure	Disease				Δ	$t(31)$	p
	Diab.	(SD)	Divert.	(SD)			
Correct Diagnosis	59.40%	(49.90%)	59.40%	(49.90%)	0.00%	0	1.0
No. Given	1.47	(0.51)	1.53	(0.51)	-0.06	–	–
No. Lines	37.53	(12.17)	48.75	(15.88)	-11.22	-6.05	<0.000
PA Proportion	47.30%	(4.70%)	46.10%	(4.70%)	1.20%	-1.52	0.14
Patient Proportion	52.50%	(4.80%)	53.70%	(4.70%)	-1.20%	1.44	0.16
No. Consec. Turns	2.56	(3.84)	2.94	(3.66)	-0.38	-0.5	0.618
Latency (s)	30.29	(15.01)	21.8	(9.25)	8.49	-4.42	<0.000
No. Info. Requests	19.41	(6.58)	25.31	(8.95)	-5.9	-4.47	<0.000
No. Open Questions	4.03	(2.67)	5.31	(3.47)	-1.28	-1.99	0.06
No. Comp. Questions	3.25	(1.95)	4.63	(3.57)	-1.38	-1.87	0.07
No. Deep Questions	4.66	(3.23)	6.06	(5.27)	-1.41	-1.39	0.18

In the chief complaint information given to the participants (see Table 1) before interviewing the diabetic patient, it states the symptom location as the groin area of the patient, and this may account for the variance between disease conditions. The conversation with the diabetes patient were nearly 22% more likely to contain a question about the setting of the chief complaint than diverticulitis interviews. During interviews with diabetic patients the participants were significantly less likely (by 37%) to query alleviating and aggravating symptom features than in diverticulitis condition. The diabetic patient exhibited an increase in urination, the primary query regarding alleviating and aggravating symptoms was whether an increase in intake of liquids before the urge to urinate. Pain, the abdominal region of the diverticulitis patient, has several related alleviating and aggravating symptoms queries since diet, position and movement could all trigger pain depending on the cause.

Table 3.

Clinical; Measures, Means (SD), and Difference Between Means, with t-test Results.

Measure	Disease				Δ	$t(31)$	p
	Diab.	(SD)	Divert.	(SD)			
Symptom Location	0.0%	0.0%	68.8%	47.1%	-68.8%	-8.26	<0.000
Symptom Quality	75.0%	44.0%	84.4%	36.9%	-9.4%	-1.00	0.32
Symptom Severity	68.8%	47.1%	50.0%	50.8%	18.8%	1.36	0.18
Symptom Onset	81.3%	39.7%	75.0%	44.0%	6.3%	0.57	0.57
Symptom Setting	65.6%	48.3%	43.8%	50.4%	21.9%	1.75	0.09
Symptom A&A	31.3%	47.1%	68.8%	47.1%	-37.5%	-3.83	<0.000
Symptom Ass. Manif.	93.8%	24.6%	100.0%	0.0%	-6.3%	-1.44	0.16
No. ROS	8.25	4.684	11.31	6.74	-3.06	-1.98	0.056
% ROS	49.2%	30.2%	39.1%	19.6%	10.2%	1.51	0.14
% Sacred 7	69.3%	20.3%	98.1%	28.5%	-28.8%	-5.17	<0.000

Table 4.

Communication Techniques; Measures, Means (SD), and Difference Between Means, with t-test Results.

Measure	Disease				Δ	$t(31)$	p
	Diab.	(SD)	Divert.	(SD)			
% Opening Stmnts	75.0%	44.0%	71.9%	45.7%	3.1%	1	0.325
% Complaint Queries	21.9%	42.0%	34.4%	48.3%	-12.5%	-2.1	0.044
% Context Queries	100.0%	0.0%	100.0%	0.0%	0.0%	–	–
% Diagnosis Queries	9.4%	29.6%	3.1%	17.7%	6.3%	1	0.325
% Treatment Suggest.	9.4%	29.6%	3.1%	17.7%	6.3%	1.44	0.161
% Closing Statements	34.4%	48.3%	15.6%	36.9%	18.8%	2.25	0.032
% Acknowledgments	90.6%	29.6%	84.4%	36.9%	6.3%	0.81	0.423
% Agenda Setting	43.8%	50.4%	31.3%	47.1%	12.5%	0.94	0.354
% Pers. Conn.	40.6%	49.9%	34.4%	48.3%	6.3%	0.7	0.488
No. RareTerms	2.125	2.575	6.188	5.006	-4.063	-4.72	<0.000
No. Summary Stmnts	0.75	1.107	1.094	1.088	-0.344	-1.46	0.155
% First Person	96.9%	17.7%	96.9%	17.7%	0.0%	0	1

Two communication variables demonstrated variance due to disease condition, (1) percent of closing statements and (2) average usage of rare medical terms. Diabetic patient interviews were more likely (by 19%) to have closing statements than diverticulitis; this difference was statistically significant (see Table 4). The increase in closing statements for diabetes interviews suggests confidence in either the diagnosis or that all questions had been exhausted, making it unnecessary for the communication to continue. Conversely, for diabetic patient interviews, participants were less likely (by 4 terms per interview, on average) to use rare medical terms than during diverticulitis session; this difference, too,

was statistically significant (see Table 4). The result suggests that during interactions with diverticulitis patient the participants would use medical terms not familiar to general conversations because diverticulitis patient interviews focused on the physiology of the individual. Coordinating conjunctions were more used frequently for diverticulitis exchanges than while conversing with the diabetic patient; this difference approached statistical significance (see Table 5).

Table 5.

Lexical Structure; Measures, Means (SD), and Difference Between Means, with t-test Results.

Measure	Disease				Δ	$t(31)$	p
	Diab.	(SD)	Divert.	(SD)			
No. Words In Turn	15.04	8.8	13.77	6.47	1.27	0.67	0.509
No. Elliptical Turns	1.625	1.897	1.313	2.546	0.312	0.64	0.524
No. Long Turns	5.719	3.656	5.5	4.311	0.219	0.28	0.783
No. Coord. Cnjctn	7.094	2.81	8.688	5.019	-1.594	-1.81	0.08
No. Interjection	2.875	3.329	3.094	3.559	-0.219	-0.39	0.702
No. Abbreviation	0.938	1.318	1.094	1.353	-0.156	-0.54	0.596
No. Hedges	3.594	3.518	2.563	1.933	1.031	1.47	0.152
No. Evidentials	1.594	4.279	0.75	1.218	0.844	1.15	0.257
No. Idiosyncr. Sntncs	8.84	11.5	10.38	13.64	-1.54	-0.59	0.558
No. Idiosyncr. Spelling	1.094	1.802	0.781	1.641	0.313	1.14	0.264

Overall the variance exhibits patterns that support the concept that the two diseases portrayed by the Confederates were fundamentally different. During interviews with the patient with Diabetes, PA's would focus less on the chief complaint and use less medical

terminology. Diverticulitis interview exhibited a focus on the chief complaint, shown by the almost complete review of sacred seven during interviews. The clinical focus of Diverticulitis is reflected in the frequent usage of rare medical terminology during the interviews. None of the variances between the diseases are unexpected given that initiate differences of the medical conditions. Therefore the examination of results will focus on the influence of time pressure on interactions.

Time Pressure

Conversation structure. Of the 15 variables indicating a shift resulting from time pressure, 5 were related to conversational structure (See Table 6). The average number of lines exchanged in 15-minute interviews was lower than those of the 7-minute interview by 11%, a statistically significant difference. The result suggests that when given more time exchanges between PA and Patients increased the number of individual entries into the IM system.

Average number of requests for information were lower in 15-minute than in 7-minute interviews. During longer sessions participants asked on average 6 more questions than in the shorter interviews, a statistically significant difference (see Table 6). The types of questions also differed between sessions. Open-ended questions were used to a lesser frequency during the 15-minute than in the 7-minute interviews. In 15-minute interviews the participants also utilized compound questions to a greater degree than in 7-minute condition. The two results concerning question or query type suggest that the increase in request for information in 15-minute session are likely in the form of open and compound format (see Table 6). During the longer 15-minute interviews mean latency to next question was on average 8.5 s longer than that of the 7-minute sessions, a statistically significant difference. The finding suggests that the participants spent more time preparing to make the next query to the patient.

Table 6.

Conversation Structure; Measures, Means (SD), and Difference Between Means, with t-test Results.

Measure	Time Condition				Δ	$t(31)$	p
	15	(SD)	7	(SD)			
Correct Diagnosis	59.40%	(49.90%)	59.40%	(49.90%)	0.00%	0	1.0
No. Given	1.47	(0.51)	1.53	(0.51)	-0.06	–	–
No. Lines	37.53	(12.17)	48.75	(15.88)	-11.22	-6.05	<0.000
PA Proportion	47.30%	(4.70%)	46.10%	(4.70%)	1.20%	-1.52	0.14
Patient Proportion	52.50%	(4.80%)	53.70%	(4.70%)	-1.20%	1.44	0.16
No. Consec. Turns	2.56	(3.84)	2.94	(3.66)	-0.38	-0.5	0.618
Latency (s)	30.29	(15.01)	21.8	(9.25)	8.49	-4.42	<0.000
No. Info. Requests	19.41	(6.58)	25.31	(8.95)	-5.9	-4.47	<0.000
No. Open Questions	4.03	(2.67)	5.31	(3.47)	-1.28	-1.99	0.06
No. Comp. Questions	3.25	(1.95)	4.63	(3.57)	-1.38	-1.87	0.07
No. Deep Questions	4.66	(3.23)	6.06	(5.27)	-1.41	-1.39	0.18

Clinical Information Queries. Of the 15 variables indicating a shift resulting from time pressure, 5 were related to clinical technique. The “Scared Seven” were more likely (12.8%) to be queried during 15-minute interviews than in 7-minute interviews. During the 7-minute sessions the participants were less likely (by 37.5) to query patients regarding the severity of the chief complaint than 15-minute sessions, a statistically significant difference (see Table 7). The setting of the chief complaint was also less likely to be requested by the participants while under time pressure (7-minute interview) compared to non-time pressure condition (15-minute interview). The results suggest that when under time pressure queries related to severity and setting are deemed less necessary and therefore can be left out from

conversations.

The participants on average elicited a higher percentage (14.2%) total ROS cues during longer interviews than in shorter time condition. This difference was statistically significant (see Table 7). Additionally, ROS question count was significantly higher when under time pressure than not under time pressure. The results demonstrate that under time pressure the participants asked more questions regarding ROS yet did not cover the same number of topics within the list of related symptoms for each disease compared to non-time pressure exchange.

Table 7.

Clinical Queries; Measures, Means (SD), and Difference Between Means, with t-test Results.

Measure	Time Condition				Δ	$t(31)$	p
	15	(SD)	7	(SD)			
Symptom Location	34.40%	(48.30%)	34.40%	(48.30%)	0.00%	0	1.0
Symptom Quality	84.40%	(36.90%)	75.00%	(44.00%)	9.40%	-1	0.33
Symptom Severity	78.10%	(42.00%)	40.60%	(49.90%)	37.50%	-3	0.01
Symptom Onset	78.10%	(42.00%)	78.10%	(42.00%)	0.00%	0	1.0
Symptom Setting	65.60%	(48.30%)	43.80%	(50.40%)	21.90%	-1.75	0.09
Symptom A&A	56.30%	(50.40%)	43.80%	(50.40%)	12.50%	-1.07	0.29
Symptom Ass. Manif.	93.80%	(24.60%)	100.00%	(0.00%)	-6.30%	1.44	0.16
No. ROS	7.88	(4.01)	11.69	(6.97)	-3.82	-2.56	0.016
% ROS	51.30%	(29.00%)	37.00%	(20.20%)	14.20%	-2.2	0.04
% Sacred 7	90.10%	(26.20%)	77.30%	(29.60%)	12.80%	-1.77	0.09

Communication Techniques. The next group of variables pertained to communication techniques used by the participants to elicit relevant information from the confederate “patient”.

Table 8.

Measures, Means (SD), and Difference Between Means, with t-test Results.

Measure	Time Condition				Δ	$t(31)$	p
	15	(SD)	7	(SD)			
% Opening Stmnts	75.00%	(44.00%)	71.90%	(45.70%)	3.10%	1	0.325
% Complaint Queries	25.00%	(44.00%)	31.30%	(47.10%)	-6.30%	-1	0.325
No. Cmplnt Queries	4.25	(3.45)	6.25	(5.88)	-2	-3.13	0.004
% Context Queries	100.00%	(0.00%)	100.00%	(0.00%)	0.00%	–	–
No. Context Queries	10.34	(4.84)	12.44	(5.85)	-2.1	-2.45	0.02
% Diagnosis Queries	9.40%	(29.60%)	3.10%	(17.70%)	6.30%	1	0.325
% Trtmnt Suggestions	6.30%	(24.60%)	6.30%	(24.60%)	0.00%	0	1.0
% Closing Stmnts	21.90%	(42.00%)	28.10%	(45.70%)	-6.30%	-0.7	0.488
% Acknwldgmnts	93.80%	(24.60%)	81.30%	(39.70%)	12.50%	1.68	0.103
No. Acknwldgmnts	3.97	(2.34)	4.06	(3.35)	-0.09	-0.17	0.87
% Agenda Setting	46.90%	(50.70%)	28.10%	(45.70%)	18.80%	1.44	0.161
No. Agenda Setting	0.78	(1.21)	0.81	(1.6)	-0.03	-0.08	0.934
% Pers. Conn.	46.90%	(50.70%)	28.10%	(45.70%)	18.80%	2.25	0.032
No. RareTerms	3.69	(3.12)	4.63	(5.48)	-0.94	-0.84	0.407
No. Summary Stmnts	0.78	(0.94)	1.06	(1.24)	-0.28	-1.18	0.247
% First Person	96.90%	(17.70%)	96.90%	(17.70%)	0.00%	0	1.0
No. First Person	6.09	(8.87)	6.94	(5.03)	-0.85	-0.54	0.594

The difference between the time conditions was statistically significant in only two of the measures (see Table 8). During the 7-minute sessions participants asked on average 2 more questions related to the main patient complaint than during the 15-minute sessions; the difference was statistically significant. The results suggest that with less time, the participants increased questioning focused on the chief complaint that brought the patient in for consultations. Communication pattern in the 7-minute session included on average 2 more queries that were related to general patient health than in 15-minute interviews. This difference, too, was statistically significant. The longer 15 minute interviews were 19% more likely to include statements by the participant that were intended to create a personal connection than the shorter 7-minute sessions, a statistically significant difference. The communication pattern exhibited by participants when under time pressure showed an increased focus on the investigation role during communication but a lowering in attempts to humanize the conversation by connecting with the patient at a personal level.

Lexical Structure. Of the variables related to lexical structure, only two showed statistically significant difference between the time conditions. On average participants communication under time pressure (7-minute interview) had on average 8 more words per turn than in the longer interview, a statistically significant difference. The time pressure condition also demonstrated higher usage of coordinating conjunctions, on average 2 more than in the 15-minute interviews, a statistically significant difference (see Table 9). The results suggest that during time pressure condition the participants used longer queries often containing coordinating conjunctions to connect the longer string of words. Under time pressure the participants also increased their usage of elliptical turns compared to the longer interviews. The result implies that the participants, when placed under pressure, used more short sentences. In the 7-minute sessions the participants hedged their statements more often than in the 15-minute interviews. The almost identical results of the t-test for elliptical turns and hedges suggest that hedging statements make up a majority of elliptical statements (see Table 9). Lexical variables demonstrate that under time pressure the participants used dense lines and displayed more indication of uncertainty.

Table 9.

Lexical Structure; Measures, Means (SD), and Difference Between Means, with t-test Results.

Measure	Time Condition				Δ	$t(31)$	p
	15	(SD)	7	(SD)			
No. Words In Turn	10.31	(4.05)	18.5	(8.32)	-8.19	-6.7	<0.000
No. Elliptical Turns	1.06	(1.61)	1.88	(2.69)	-0.81	-1.75	0.091
No. Long Turns	5.59	(3.75)	5.63	(4.23)	-0.03	-0.04	0.969
No. Coord. Conj.	6.91	(2.9)	8.88	(4.9)	-1.97	-2.3	0.028
No. Interjection	3.03	(2.69)	2.94	(4.06)	0.09	0.17	0.87
No. Abbreviation	0.84	(0.85)	1.19	(1.67)	-0.34	-1.2	0.239
No. Hedges	2.47	(2.19)	3.69	(3.34)	-1.22	-1.76	0.088
No. Evidentials	0.66	(0.87)	1.69	(4.34)	-1.03	-1.43	0.164
No. Idiosyncr. Sntncs	8.91	(10.11)	10.31	(14.71)	-1.4	-0.54	0.591
No. Idiosyncr. Spell.	0.75	(1.61)	1.13	(1.83)	-0.38	-1.38	0.178

Discussion

Overall, when all significant cues for time pressure are viewed holistically, it suggests that when under time pressure PA are shifting to a query exchange. The increase in questioning, including high yield open-ended and compound question format support the prior assumption. The significant drop in the average percent of sacred seven elicited regarding the chief complaint suggests a reduced adherence to best practices outlined in their education at RIT. Further supported by the lower completeness of ROS querying but an increase in questions related to the lower number of ROS topics covered. Evidence of the shift to focused query exchange is shown by the reduction in personal statements and increased in a complaint and general question counts. All lines by the PAs during time pressure increase in length and often contain multiple sentences. This outcome demonstrated varying degrees of support for components of the hypothesis. To reiterate, the hypotheses was:

Under time pressure, the PA students will adopt an effective style of communication, characterized by patient involvement and adaptive questioning pattern that manifested an increase in open-ended questions, percent of sacred seven queried, agenda setting statements, mean latency, and decrease in personal connection statements, medical terminology, and queries.

The results suggest that when faced with time pressure, clinicians will leverage open-ended questions and demonstrate a shift away from personal connections, enabling them to focus on the medical task. Open-ended questions had consistently demonstrated to be an effective means of gathering large amounts of information. Additionally, the significant increase in the usage of hedging statements as an expression of uncertainty was expected (Ogden et al., 2002). The conflicting results of increased queries, increased words per entry, reduced adherence to symptom attributes and mean latency, display a pattern that has several potential causes. These interactions can be consolidated into two themes, experience and the experimental paradigm.

Table 10.

Measures, Means, and Difference Between Means, by Experience Level of Participants.

Experience	3rd			4th			Alum.		
	15	7	Δ	15	7	Δ	15	7	Δ
Time Cond.									
% Corr. Diag	1.0	0.5	0.5	0.6	0.6	0.0	0.7	0.8	-0.2
No. Lines	36.4	44.8	-8.4	40.2	54.1	-13.9	32.3	41.0	-8.7
Words in Turn	12.9	22.1	-9.1	9.8	19.8	-10.0	7.3	9.1	-1.8
M. Latency	36.6	26.0	10.6	26.6	19.5	7.2	29.4	20.4	9.0
No. Info. Req.	17.7	22.8	-5.1	20.2	26.6	-6.4	20.2	26.0	-5.8
No. Open Q.	3.2	6.0	-2.8	4.4	4.8	-0.3	4.3	5.7	-1.3
% Sacred 7	0.9	0.8	0.1	0.9	0.8	0.2	0.8	0.8	0.1
Smpt. Location	0.3	0.2	0.1	0.4	0.3	0.1	0.2	0.7	-0.5
Smpt. Quality	0.8	0.9	-0.1	0.9	0.7	0.2	0.8	0.7	0.2
Smpt. Severity	0.9	0.2	0.7	0.8	0.6	0.1	0.7	0.2	0.5
Smpt. Onset	0.8	0.8	0.0	0.8	0.8	0.0	0.8	0.8	0.0
Smpt. Setting	0.6	0.5	0.1	0.6	0.4	0.3	0.8	0.5	0.3
Smpt. A&A	0.4	0.7	-0.3	0.8	0.4	0.4	0.3	0.2	0.2
Smpt. Ass. Man.	1.0	1.0	0.0	0.9	1.0	-0.1	1.0	1.0	0.0
% ROS	0.5	0.4	0.1	0.5	0.3	0.2	0.4	0.5	0.0
No. ROS	8.0	12.0	-4.0	8.3	9.6	-1.3	6.5	16.7	-10.2
Hedges	1.6	4.6	-3.0	2.5	4.3	-1.8	3.8	0.7	3.2
Coord. Conj	8.4	11.4	-3.0	6.1	8.1	-2.1	6.7	6.7	0.0
% Pers. Conn.	0.4	0.3	0.1	0.5	0.3	0.3	0.5	0.3	0.2

Research has shown that experience influences how medical professionals interact with patients. Based on Benner (1982) five categories of clinical development variability, in approach to time pressure should be indicated with our results. The PA students who participated in the study were either third year (N = 10) or fourth year (N = 16) students or alumni (i.e., graduated and practicing PAs; N=6). The majority of participants for this study were still finishing their academic education. A primary characteristic of these groups is the lack of internalization of cue probability in their approach (Benner, 1982; King & Clark, 2002). When the variables that showed significant variance due to time pressure are viewed based on experience, distinct approach patterns were exhibited (see Table 10). All participants demonstrated an increase in querying when faced with less time, but the structure and clinical focus varied.

Under time pressure, third year students focused on gathering large amounts of information and expressed uncertainty in their actions. The average line word density of a third year student was similar to that of a fourth year student. Under time pressure, the approach shifted to an increase in hedging statements, open-ended questions and coordinating conjunctions. Third year students asked more questions at an average of 10.6 seconds faster than when not under time pressure. Each third year student asked less of the total Sacred Seven and ROS. Under time pressure, the frequency of the chief complaint was not queried as often; instead alleviating/aggravating and symptom quality increased in focus. Overall, diagnostic accuracy of third year students was reduced by half, displaying an approach that corresponds to beginner or novice behavior. Third year students have limited experience with patients and are therefore forced to rely solely on a still forming knowledge base that does not integrate symptoms based on probabilistic reasoning.

Fourth year students displayed a similar increase in word density per line and usage of coordinating conjunctions as third year students. Fourth year students without time pressure displayed an adherence to clinical training with the highest Sacred Seven percent and review of system inquiries. When faced with time pressure the adherence to both decreased. The count of ROS queried showed only a small increase compared to both third

year students year and alumni. Queries regarding the chief complaint attribute decreased with no single type demonstrating dominance. The number of fourth year students who attempted to make a personal connection with the patient dropped by half under time pressure. No difference in accuracy between the time conditions was observed. Fourth year students have interactions with patients enabling them to begin to link their knowledge base with experience, yet illness scripts do not seem to hold when exposed to pressure.

Alumni demonstrated a similar need to request more information from the patients as third- and fourth year students, but their approach differed from the latter groups. Alumni leveraged slightly more open-ended questions but did not show a difference in the usage of coordination conjunctions between the time conditions. They also maintained a consistent number of words per line and asked a similar number of the chief complaint attribute questions in both time conditions. However, they asked slightly more of the ROS total than the students. During longer sessions, alumni did not often query the patient regarding the location of the chief complaint but under time pressure this attribute query drastically increased. The second shift in symptom attribute query was a reduction in frequency inquiries. The change in symptom attribute election suggests that the alumni selectively queried symptom attributes in a possibly consistent manner. Third- and fourth year students demonstrated an increased usage of hedging statements under time pressure but alumni almost eliminated their usage during time pressure. The developing knowledge base and confidence of the PAs suggests progressively more effective diagnosis from the third year to fourth year students to alumni. The variances in approaches provide possible rational for all significant finding except the increase in queries and reduction in mean latency exhibited by all levels of experience.

The first possible source of the increasing querying is that PAs quickly identified and gathered evidence to support their main hypothesis when under time pressure, but utilized the remainder of the time to eliminate alternative hypotheses. The time needed to achieve an acceptable level of confidence was reached early in exchange. The remainder of the time was spent querying broadening topics and eliminating alternative hypotheses. Several studies

found that if given an increase in time, the PA will leverage any time beyond the minimum threshold to ask a range of follow-up questions. Time spent querying the patient beyond threshold did not correlate with increased accuracy. Further research into the minimum time needed to make a decision should be investigated using the novel paradigm presented in this study.

The other possible source for the increased querying while under time pressure is that participants were not viewing the patients in this study as actual people. The novel mode of communication enabled participants to focus on the diagnostic task and less on the patient's emotional state. The lack of non-verbal communication and patient physical presence could have played a role. Time pressure could amplify this effect.

The novel design paradigm may have also influenced mean latency. In face to face exchanges with patients, clinicians have to wait for the patient to finish responding to each question not to be rude. Communication over IM systems allowed the participants to begin typing their next statement without interrupting the patient's response. This approach was observed during sessions when the moderator was present in the same room. Further exploration into mean latency of response should account for this occurrence.

Conclusion

Time pressure acted as a catalyst to highlight variance in communication patterns of participants (PA students and alumni). The majority of results can be traced to have a relationship to experience differences among participants. All participants regardless of experience exhibited a clear focus on questioning instead of patient-centered communication when communicating through online technology. Future studies also need to take into account the pre-emptive input of questions to more accurately leverage mean latency as an outcome variable.

References

- Banning, M. (2008). A review of clinical decision making: models and current research. *Journal of Clinical Nursing*, 17(2), 187–195.
- Benner, P. (1982). From novice to expert. *AJN The American Journal of Nursing*, 82(3), 402–407.
- Berger, J. O. (2013). *Statistical decision theory and bayesian analysis*. Springer Science & Business Media.
- Bergus, G. R., Chapman, G. B., Gjerde, C., & Elstein, A. S. (1995). Clinical reasoning about new symptoms despite preexisting disease: sources of error and order effects. *Family medicine*, 27(5), 314–320.
- Bickley, L., & Szilagyi, P. G. (2012). *Bates' guide to physical examination and history-taking*. Lippincott Williams & Wilkins.
- Bordage, G. (1999). Why did i miss the diagnosis? some cognitive explanations and educational implications. *Academic Medicine*, 74(10), S138–143.
- Bordage, G., & Zacks, R. (1984). The structure of medical knowledge in the memories of medical students and general practitioners: categories and prototypes. *Medical e*, 18(6), 406–416.
- Boyle, D., Dwinnell, B., & Platt, F. (2005). Invite, listen, and summarize: a patient-centered communication technique. *Academic Medicine*, 80(1), 29–32.
- Brennan, T. A., Leape, L. L., Laird, N. M., Hebert, L., Localio, A. R., Lawthers, A. G., ... Hiatt, H. H. (1991). Incidence of adverse events and negligence in hospitalized patients: Results of the Harvard Medical Practice Study. *New England Journal of Medicine*, 324(6), 370–376.
- Brunett, P. H., Campbell, T. L., Cole-Kelly, K., Danoff, D., Frymier, R., Goldstein, M. G., ... others (2001). Essential elements of communication in medical encounters: the kalamazoo consensus statement. *Academic Medicine*.
- Chamberland, M., St-Onge, C., Setrakian, J., Lanthier, L., Bergeron, L., Bourget, A., ... Rikers, R. (2011). The influence of medical students' self-explanations on diagnostic

- performance. *Medical Education*, 45(7), 688–695.
- Croskerry, P. (2009). Clinical cognition and diagnostic error: Applications of a dual process model of reasoning. *Advances in Health Sciences Education*, 14(1), 27–35.
- Cutler, S. (2005). Ageism and technology. *Generations*, 29(3), 67–72.
- David, L. R. B. H., Guyatt, G. H., & Tugwell, P. (1991). *Clinical epidemiology: A basic science for clinical medicine*. Boston, MA: Little Brown and Company.
- Duffy, F. D., Gordon, G. H., Whelan, G., Cole-Kelly, K., Frankel, R., et al. (2004). Assessing competence in communication and interpersonal skills: the kalamazoo ii report. *Academic Medicine*, 79(6), 495–507.
- Elstein, A. S., & Schwarz, A. (2002). Clinical problem solving and diagnostic decision making: selective review of the cognitive literature. *British Medical Journal*, 324(7339), 729.
- Fallowfield, L., Jenkins, V., Farewell, V., & Solis-Trapala, I. (2003). Enduring impact of communication skills training: results of a 12-month follow-up. *British journal of cancer*, 89(8), 1445–1449.
- Farnan, J. M., Johnson, J. K., Meltzer, D. O., Harris, I., Humphrey, H. J., Schwartz, A., & Arora, V. M. (2010). Strategies for effective on-call supervision for internal medicine residents: the superb/safety model. *Journal of Graduate Medical Education*, 2(1), 46–52.
- Graber, M. L., Franklin, N., & Gordon, R. (2005). Diagnostic error in internal medicine. *Archives of Internal Medicine*, 165(13), 1493–1499.
- Groves, M., O'Rourke, P., & Alexander, H. (2003). The clinical reasoning characteristics of diagnostic experts. *Medical Teacher*, 25(3), 308–313.
- Harvey, K., & Koteyko, N. (2012). *Exploring health communication: Language in action*. Routledge.
- Haskard Zolnieriek, K. B., & DiMatteo, M. R. (2009). Physician communication and patient adherence to treatment: A meta-analysis. *Medical Care*, 47(8), 826–834.
- Hochberg, L., Alm, C. O., Rantanen, E. M., DeLong, C. M., & Haake, A. (2014). Decision

- style in a clinical reasoning corpus. In *Proceedings of the bionlp workshop* (pp. 83–87).
- Hooker, R. S., Hogan, K., & Leeker, E. (2007). The globalization of the physician assistant profession. *The Journal of Physician Assistant Education*, 18(3), 76–85.
- Hunink, M. G. M., Weinstein, M. C., Wittenberg, E., Drummond, M. F., Pliskin, J. S., Wong, J. B., & Glasziou, P. P. (2014). *Decision making in health and medicine: Integrating evidence and values*. Cambridge University Press.
- Institute of Medicine. (2000). *To err is human: Building a safer health system* (Vol. 6). Washington, DC: National Academies Press.
- Joyce, B. L., Steenbergh, T., & Scher, E. (2010). Use of the kalamazoo essential elements communication checklist (adapted) in an institutional interpersonal and communication skills curriculum. *Journal of Graduate Medical Education*, 2(2), 165–169.
- Kahneman, D. (2003). A perspective on judgment and choice: Mapping bounded rationality. *American psychologist*, 58(9), 697–720.
- Kassirer, J. P., Kopelman, R. I., & Wong, J. B. (1991). *Learning clinical reasoning*. Williams & Wilkins Baltimore.
- Khalib, A. L., & Farid, A. R. (2010). Stopping doctor-patient communication gap: The ten essential methods. *Journal of Community Health*, 16(1).
- King, L., & Clark, J. M. (2002). Intuition and the development of expertise in surgical ward and intensive care nurses. *Journal of advanced nursing*, 37(4), 322–329.
- Klein, G. A. (1993). A recognition-primed decision (RPD) model of rapid decision making. In G. A. Klein, J. Orasanu, R. Calderwood, & C. E. Zsombok (Eds.), *Decision making in action: Models and methods* (pp. 138–147). Westport, CT: Ablex Publishing.
- Li, R., Pelz, J., Shi, P., & Haake, A. R. (2012). Learning image-derived eye movement patterns to characterize perceptual expertise. In N. Miyake, D. Peebles, & R. P. Cooper (Eds.), *Proceedings of the 34th Annual Meeting of the Cognitive Science Society* (pp. 190–195). Austin, TX: Cognitive Science Society.
- Lipkin, M., Quill, T. E., & Napodano, R. J. (1984). The medical interview: a core curriculum for residencies in internal medicine. *Annals of Internal Medicine*, 100(2),

277–284.

- Lypson, M., Page, A., Bernat, C., & Haftel, H. (2013). *Patient-Doctor Communication. The Fundamental Skill of Medical Practice*. Ann Arbor, MI: University of Michigan Medical School.
- Makary, M. A., & Daniel, M. (2016). Medical error—the third leading cause of death in the US. *BMJ*, 353(i2139).
- Malhotra, N. K. (1982). Information load and consumer decision making. *Journal of Consumer Research*, 419–430.
- Mauksch, L. B., Dugdale, D. C., Dodson, S., & Epstein, R. (2008). Relationship, communication, and efficiency in the medical encounter: creating a clinical model from a literature review. *Archives of Internal Medicine*, 168(13), 1387–1395.
- McColl, A., Smith, H., White, P., & Field, J. (1998). General practitioners' perceptions of the route to evidence based medicine: a questionnaire survey. *BMJ*, 316(7128), 361–365.
- McCoy, W., Pelz, J. B., Alm, C. O., Shi, P., Calvelli, C., & Haake, A. (2012). Linking uncertainty in physicians' narratives to diagnostic correctness. In *Proceedings of the workshop on extra-propositional aspects of meaning in computational linguistics* (pp. 19–27).
- McKenna, H. P., Ashton, S., & Keeney, S. (2004). Barriers to evidence-based practice in primary care. *Journal of advanced nursing*, 45(2), 178–189.
- Migongo, A. W., Charnigo, R., Love, M. M., Kryscio, R., Fleming, S. T., & Pearce, K. A. (2012). Factors relating to patient visit time with a physician. *Medical Decision Making*, 32(1), 93–104.
- Moote, M., Krsek, C., Kleinpell, R., & Todd, B. (2011). Physician assistant and nurse practitioner utilization in academic medical centers. *American Journal of Medical Quality*, 26(6), 452–460.
- Murphy, J. G., & Dunn, W. F. (2010). Medical errors and poor communication. *Chest Journal*, 138(6), 1292–1293.

- Nevalainen, M. K., Mantyranta, T., & Pitkala, K. H. (2010). Facing uncertainty as a medical student—a qualitative study of their reflective learning diaries and writings on specific themes during the first clinical year. *Patient Education and Counseling*, 78(2), 218–223.
- Norman, G. R., & Eva, K. W. (2010). Diagnostic error and clinical reasoning. *Medical Education*, 44(1), 94–100.
- Ogden, J., Fuks, K., Gardner, M., Johnson, S., McLean, M., Martin, P., & Shah, R. (2002). Doctors expressions of uncertainty and patient confidence. *Patient Education and Counseling*, 48(2), 171–176.
- Parks Associates. (2014, September). *Doctor-patient video consultations will nearly triple from 5.7 million in 2014 to over 16 million in 2015*. Retrieved February, 2016, from <http://www.parksassociates.com/blog/article/doctor-video-consultations-are-on-the-rise>
- Phillips, R. L., Bartholomew, L. A., Dovey, S. M., Fryer, G., Miyoshi, T., & Green, L. (2004). Learning from malpractice claims about negligent, adverse events in primary care in the united states. *Quality and Safety in Health Care*, 13(2), 121–126.
- Redelmeier, D. A., Ferris, L. E., Tu, J. V., Hux, J. E., & Schull, M. J. (2001). Problems for clinical judgement: introducing cognitive psychology as one more basic science. *Canadian Medical Association Journal*, 164(3), 358–360.
- Roblin, D. W., Howard, D. H., Becker, E. R., Adams, K. E., & Roberts, M. H. (2004). Use of midlevel practitioners to achieve labor cost savings in the primary care practice of an mco. *Health Services Research*, 39(3), 607–626.
- Schiff, G. D., Kim, S., Abrams, R., Cosby, K., Lambert, B., Elstein, A. S., ... McNutt, R. A. (2005). Diagnosing diagnosis errors: lessons from a multi-institutional collaborative project. In K. Henriksen, J. B. Battles, E. S. Marks, & D. I. Lewin (Eds.), *Advances in patient safety: From research to implementation* (Vol. 2, pp. 255–278). Agency for Healthcare Research and Quality (US).
- Schmidt, H. G., & Rikers, R. M. (2007). How expertise develops in medicine: knowledge

- encapsulation and illness script formation. *Medical Education*, 41(12), 1133–1139.
- Schneider, W., & Shiffrin, R. M. (1977). Controlled and automatic human information processing: I. detection, search, and attention. *Psychological review*, 84(1), 1.
- Schubert, C. C., Denmark, T. K., Crandall, B., Grome, A., & Pappas, J. (2013). Characterizing novice-expert differences in macrocognition: an exploratory study of cognitive work in the emergency department. *Annals of Emergency Medicine*, 61(1), 96–109.
- Shaban, R. (2012). Theories of clinical judgment and decision-making: A review of the theoretical literature. *Australasian Journal of Paramedicine*, 3(1), 8.
- Simon, H. A. (1959). Theories of decision-making in economics and behavioral science. *The American Economic Review*, 49(3), 253–283.
- Simon, H. A., & Newell, A. (1971). Human problem solving: The state of the theory in 1970. *American Psychologist*, 26(2), 145.
- Smith, A. (2014, April). *Usage and adoption*. Retrieved February, 2016, from <http://www.pewinternet.org/2014/04/03/usage-and-adoption/>
- Tsiga, E., Panagopoulou, E., Sevdalis, N., Montgomery, A., & Benos, A. (2013). The influence of time pressure on adherence to guidelines in primary care: an experimental study. *BMJ open*, 3(4), e002700.
- Tversky, A., & Kahneman, D. (1974). Judgment under uncertainty: Heuristics and biases. *Science*, 185(4157), 1124–1131.
- Whiting, P., Toerien, M., de Salis, I., Sterne, J. A., Dieppe, P., Egger, M., & Fahey, T. (2007). A review identifies and classifies reasons for ordering diagnostic tests. *Journal of clinical epidemiology*, 60(10), 981–989.
- Wickens, C. D., & Hollands, J. G. (2000). *Engineering psychology and human performance*. New York: Prentice Hall.
- Woods, N. N., Howey, E. H., Brooks, L. R., & Norman, G. R. (2006). Speed kills? speed, accuracy, encapsulations and causal understanding. *Medical Education*, 40(10), 973–979.
- Yedidia, M. J., Gillespie, C. C., Kachur, E., Schwartz, M. D., Ockene, J., Chepaitis, A. E.,

... Lipkin Jr, M. (2003). Effect of communications training on medical student performance. *Journal of American Medical Association (JAMA)*, 290(9), 1157–1165.

Appendix A: RIT IRB Approval of Project**R·I·T****Rochester Institute of Technology****Form C
IRB Decision Form**

RIT Institutional Review Board for the
Protection of Human Subjects in Research
141 Lomb Memorial Drive
Rochester, New York 14623-5604
Phone: 585-475-7673
Fax: 585-475-7990
Email: hmfsrcs@rit.edu

TO: Nicholas Luliucci
FROM: RIT Institutional Review Board
DATE: November 2, 2012
RE: **Decision of the RIT Institutional Review Board**

Project Title – Physicians' Diagnostic Decision Making and Patient History Elicitation

The Institutional Review Board (IRB) has taken the following action on your project named above.

☒ Approved, no greater than minimal risk

Now that your project is approved, you may proceed as you described in the Form A. **Note that this approval is only for a maximum of 12 months; you may conduct research on human subjects only between the date of this letter and November 2, 2013.**

You are required to submit to the IRB any:

- Proposed modifications and wait for approval before implementing them,
- Unanticipated risks, and
- Actual injury to human subjects.

Return the Form F, at the end of your human research project or 12 months from the above date. If your project will extend more than 12 months, your project must receive continuing review by the IRB.

Continuing review of research and approval of research studies is required so long as the research study is ongoing, that is, until research-related interactions and interventions with human subjects or the obtaining and analysis of identifiable private information described in the IRB-approved research plan have been completed.

Investigators are responsible for submitting sufficient materials and information for the IRB to meet its regulatory obligations, and should follow the institutional policies and procedures for continuing IRB review of research that are required by HHS regulations at ([45 CFR 46.103\(b\)\(4\)](#)), [45 CFR 46.109\(e\)](#), [45 CFR 46.115\(a\)\(1\)](#)) as appropriate to the research activity.



Heather Foti, MPH
Associate Director
Office of Human Subjects Research

Revised 02.09.2011

Appendix B: Informed Consent

Informed Consent for Behavioral Research Study

Nicholas Iuliucci
Graduate Student, Department of Psychology
Tel. (585) 313-1617 ; email nji7266@rit.edu

Dr. Esa M. Rantanen
Associate Professor, Department of Psychology
Tel. (585) 475-4412; email esa.rantanen@rit.edu

INTRODUCTION

You are invited to join a research study to look at communication in the medical field. The decision to join, or not to join, is up to you.

In this research study, we are investigating communication techniques of medical students during clinical consultations. Clinical consultation, together with physical examination, is critical for accurate diagnosis of medical conditions.

WHAT IS INVOLVED IN THE STUDY?

You will be asked to provide medical consultation to two "patients" and diagnose them based on their symptoms. While the "patients" are actors with fictional medical issues, we ask that you do your best to diagnose them. You will consult two patients, one with unlimited time, another with a time limit. After each patient, you will be asked to provide a differential for your diagnosis and complete a short questionnaire. When you have completed the questionnaire, an investigator will ask follow up questions to each consultation. The consultations will be done and recorded through instant messaging. Your name will not appear in the transcript.

The investigators may stop the study or take you out of the study at any time they judge it is in your best interest. They may also remove you from the study for various other reasons. They can do this without your consent.

You can stop participating at any time. If you stop you will not lose any benefits.

RISKS

There are no physical or psychological risks that would exceed those in everyday normal interactions between students. The social risks are mitigated by the fact that the patients are fictional and that parameters used for assessment are novel. There are no legal risks since the interaction is staged and the "patient" is an actor and all related information is fictional.

There may also be other risks that we cannot predict.

BENEFITS TO TAKING PART IN THE STUDY?

You may benefit from this research through a chance to practice your consultation and conversational skills with patients. However, we can't guarantee that you will personally experience benefits from participating in this study. Others may benefit in the future from the results of this study.

CONFIDENTIALITY

Your name will not be used when data from this study are published.

We will take the following steps to keep information about you confidential, and to protect it from unauthorized disclosure, tampering, or damage:

You will only be identified by an assigned code consisting of a letter and a number. This will ensure that your identity is protected in all written documents. The primary investigator will be the only individual with a key connecting the true identities and the identity codes, and the key will be kept secure in a locked cabinet in a locked room separate from all other materials used in or produced by this study. The transcript from the consultation via instant messaging will not have your name or other identifiable information. Findings from this study will only be used for academic purposes.

YOUR RIGHTS AS A RESEARCH PARTICIPANT?

Participation in this study is voluntary. You have the right not to participate at all or to leave the study at any time. Deciding not to participate or choosing to leave the study will not result in any penalty or loss of benefits to which you are entitled, and it will not harm your relationship with the investigator.

If you decide to leave the study, inform the investigator that you wish to terminate your participation in the study. You will then be debriefed and if you have not, you will be asked to sign a confidentiality agreement. We ask that you not discuss the contexts of the study to peers and friends, since they may be asked to participate.

CONTACTS FOR QUESTIONS OR PROBLEMS?

Call Nicholas Iuliucci at (585)313-1617 or email at nji7266@rit.edu if you have questions about the study, any problems, unexpected physical or psychological discomforts, any injuries, or think that something unusual or unexpected is happening.

Consent of Subject (or Legally Authorized Representative)

Signature of Subject or Representative	Date
--	------

Signature of the Investigator	Date
-------------------------------	------

Upon signing, the subject or the legally authorized representative will receive a copy of this form, and the original will be held in the subject's research record.

Appendix C: Confederate Patient Script; ‘Elliot Hu’ (Diabetes)

This is the scripted patient interviews the confederate relied on when interacting with the participants. Suggested verbal responses are in quotes.

Details for Chief Complaint

Color: When Elliot goes to the bathroom the urine is light clear in color; “it looks clear to me”.

Duration: Elliot feels as though he is spends a lot of time taking trips to the bathroom; “I go to the bathroom at work multiple times and at home”.

Persistence: Elliot is able to sleep through the night but upon waking he needs to rush to the bathroom to relieve the pressure; “I never wake up during the night, just to pee but right in the morning I can barely make it”. “I was late for work a few days ago and I have to pull over. I ended up going to the bathroom in the woods”.

Frequency: This has been occurring for the past 2 to 3 months; “I guess that it has been going on for maybe 2 to 3 months, per day I would say that I go to end up going 7 to 8 times a days”.

Control: During these visits to the restroom, Elliot has been able to control the stream and start or stop during voiding; “I haven’t been wetting my pants or anything like that, I can hold it till I make it to the restroom”.

Pain: There is also no pain during the urination, no leakage, or pain in the genital area; “There isn’t really any pain”.

General

Fever: Not feverish; “No, I haven’t felt feverish”.

Chills: Not experiencing chills; “I have not been experiencing chills”.

Stiffness: Not experiencing stiffness in his body (more than the normal); “I feel stiff sometimes but I always do after a full day at work, sitting in my desk”.

Fatigue: Feeling tired lately; “I end up yawning a lot at work, I come home from work and I just want to go back to bed”.

Onset: In between meals, but mainly in the morning; “I feel tired in the morning

but feel better for a little during the day; by the end of the work day, I feel drained”.

Alleviating and/or Aggravating: Only feels better with coffee or in the evening after lunch, has tried eating energy bars but this doesn’t seem to help; “Coffee helps but only for a while, I tried energy bars for a while but they don’t help, eating lunch or snacks keep me going for a short while”.

Sleep habits: Elliot sleeps 6-9 hours a night; “I sleep 6 to 9 hours a night”.

Weight gain: Elliot has been noticing that he has gained weight, which he estimates to be about 8 pounds over the past 3 weeks, but he has gone up a pants size and can’t get enough food; without food he starts to like he will pass out; “I have been gaining weight. I went up a 3 pants sizes from a 40 to a 43 inches. I want to go back down but I can’t stop eating or I may fall asleep”.

Medical History

Minor physical injury: Elliot cut his hand 3 weeks ago and it still hasn’t healed well; “I cut my hand, while cooking pasta on Sunday, but that was three weeks ago”.

Mono: Elliot had mono in college, which made him drop out of school for a year; “My first year in college, I got mono. It was so bad that I had to drop out. I took the year off and just worked at a local gas station”.

Broken left leg: Elliot broke his leg in high school playing football (1996); “I broke my leg in high school. I was a lineman and a guy on the other team fell on my left leg”.

Persistent illness: Elliot was diagnosed with exercise induced asthma at age 15, but is currently on no medications; “During gym class in high school, I had an asthma attack. My doctor said it was exercised induced. I was never put on any medication”.

Social

Birth place: Elliot was born in Dallas, Texas; “I was born in Dallas, Texas; it was in a small apartment in downtown”.

Current place of residence and work: Rochester, NY, work at Paychex; “I work at Paychex’s at their Henrietta location”.

Job: Accountant; “I am an accountant”.

Atmosphere: Slow and mundane, his boss is nice and a promotion is more than likely soon; “Work is boring and slow but my boss has hinted that I am in line for a promotion”.

Social life: Elliot was active in Dallas, but since he moved, he has not been going out as much, only once every other week; “Meeting new people has been slow since I moved, but I have been going to the bars with co-workers on Fridays.”

Love life. Elliot is not dating anyone, although he had before he moved to Rochester; “I did have a girlfriend but it ended when I moved to NY for work.”

Sexual activity: Elliot has not been sexually active since his ex-girlfriend (they hey dated for 3–4 years or so); “No, not been with anyone since I left Texas.”

Exercise: Elliot walks 5 days a week for 30 minutes, but has not done this lately, as he is too tired to walk; “I walk around the my neighborhood, it probably takes 30 minutes, lately though I haven’t been able o fit walks in my day.”

Alcohol: Elliot consumes 4-5 drinks a week of alcohol; “Many, 4–5 drinks a week”.

Settings: T-Foots in Fairport; “I go to T-Foot in the village of Fairport, but not that often because I still don’t know that many people in the area”.

First drink: At 18 at his friend’s house back in Texas: “Jack and me took his dads scotch and drank half... we filled it up with water but Jack still got in trouble”.

Favorite drink: Jack and Coke, Molson; “I have always been a fan of Jack and Cokes, Molson for Beer”.

Dietary habits: Elliot’s dietary habits are 3 meals a day consisting of pasta and meats mainly with a side of vegetables, snacking (sweets) 5–6 times a day, and at meals Elliot enjoys a soda (regular not diet) . Elliot also has been drinking a large amount going through 5–6 water bottles a day; “Overall, I eat fairly well. I always have my three meals a day. Usually I make pasta and steaks or burgers, just something I can make quickly after work. I try to carry my water bottle and PowerBars with me. I end up grabbing bottle of coke since I usually run through the first water bottle. I would say I go through 5–6 bottles of water”.

Favorite food: Pizza (Pontillos); “I like to eat Pontillos pizza a lot”.

Dinner: Elliot eats pasta and meat for dinners often with dessert; “Usually I have some meat with pasta, I love sweets so I usually sneak that in as dessert.”

Lunch: Elliot eats fast food and deli style sandwiches; “I grab fast food at a joint near my work or make sandwiches”.

Breakfast: “Elliot normally has a bagel or cereal in the morning; “I usually eat a bagel or cereal in the morning”.

Snacks: Elliot eats PowerBars and pop-tarts for snacks; “When I get hungry during the day, I end up eating a PowerBar or pop-tart for a quick snack”.

Smoking: Elliot does not smoke; I have never been tempted to smoke”.

Family History

Father: Elliot’s father died in a car crash, his father was 25 years old; “My father died in a car crash, he was 25.”

Mother: Elliot’s mother has a history of high blood pressure but has kept physically active; “My mother is still alive, she is 63 and is a health nut! She runs every day and actually runs a zumba class on weekends”. Elliot’s relationship with his mother is strong; “My mother is my rock, she is a wonderful woman. When my father died she did her best to take care of me. I couldn’t ask for more”. Elliot’s mother was diagnosed with high blood pressure 10 years ago; “About ten years ago my mother was diagnosed with high blood pressure, since then she has become obsessed with healthy lifestyle.”

Siblings: Elliot has no siblings; “I don’t have any siblings”.

Grandmother (father’s side): Elliot cannot remember what eye disorder his father’s mother had but she died 15 years ago; “I can’t remember, what eye disorder my grandmother (my father’s mother) had, but she died 15 years ago.”

Grandmother (mother’s side): Elliot’s grandmother was said to have “the sugars”; “My grandmother had the sugars, but she died 20 years ago.”

Appendix D: Confederate Patient Script; “Mary Hoddack” (Diverticulitis)

This is the the scripted patient interviews the confederates relied on when interacting with the participants. Suggested verbal responses are in quotes.

Chief Complaint

Onset: For the past 4 days, 1–2 times a day. The pain lasts for half hour at a time; “It has been bothering me for four days now, maybe one or twice a day but it comes and goes, it lasts for my whole soap!”

Location: Mary has been experiencing an ache tenderness in the left lower quadrant of her abdomen; “There is this throbbing pain in my stomach area, it hurts if I put too much pressure on that area.”

Intensity: On a pain scale (1 = little to no pain, 10 = unbearable), Mary would place the pain as a 3 to 4 (an ache tenderness); “I guess if I had to rate the pain, I would say it is a 3 or a 4.”

Aggravating: The pain is aggravated by eating; “The pain gets worse when I try to finish my meal”.

Alleviated: Mary reported that the pain is relieved by bowel movements or not eating; “The pain seems to go away once I use the bathroom or just stop eating.”

Review of Systems; General Medical Problems

Weight Gain: Mary has not gained or lost weight in the past month, with no foods giving her dietary issues; “I haven’t really changed in weight much over the past months.”

Vomiting: Mary has not been sick (vomiting) the past few months; “I haven’t gotten sick in a while”.

Nausea: Mary has been experiencing nausea; “Now that you mention it, I have had nausea, when I am gardening but with the summer heat, I don’t think it’s an issue. ”

Onset: Mary has been experiencing the nausea over the past few weeks, usually 10 to 15 minutes after eating; “I would say it has been happening on and off for a few weeks usually after meals”.

Alleviating: The nNausea goes away when theyI sit down and rest for an hour or

more; "It (the nausea) goes away, when I sit down or rest for a while".

Associated problem: When she has the intermittent abdominal pain she has mild nausea but no vomiting; "I feel slightly nauseous when the pain in my stomach happens."

Stools: Mary's stools are usually one bowel movement per day; "I usually use the restroom once per day". Stools are normally brown in color, the color is now darker brown to blackish in color; "It may be darker than normal". Mary reported noticing the color change four days ago; "It's been darker for, maybe, 4 days". She has noted alternating intermittent constipation and loose stools; "Sometimes I to wait for the a while in the restroom and even then it's a bit wet". She has not noted any frank blood; "I haven't really noticed any blood". Mary reports no pain associated with stools; "There is not any pain during the visits to the restroom."

Fever: Mary noted that she felt feverish even though she did not record her temperature; "Beginning yesterday, I felt a bit warm but I never actually checked my temperature".

Personal

Education and occupation: Mary attended college (Stony Brook), where she majored in elementary school teacher (she now teaches 2nd grade, and has for the past 20 years); "I went to Stony Brook for Education, which has allowed me to teach 2nd grade for the past 20 years."

Exercise: Mary has tried to stay active but taking care of her grandchildren has taken precedent, she walks intermittently; "I usually am chasing around the grand kids but sometime I get a chance to take a walk".

Dietary habits: Mary normally eats 3 meals a day; "I make sure to eat breakfast, lunch and dinner". Breakfast consists of a bagel or white toast; "I normally just grab a bagel or toast before I leave in the morning". Recently she has been eating popcorn as a snack; "I like to make popcorn as a snack". Lunch is normally a sandwich and a vegetable or fruit. Dinner varies from steak to chicken, but is limited in portions; "I usually make myself a sandwich and grab an apple or something".

Smoking: Mary quit smoking 5 years ago, but smoked for 17 years; "I smoked for

17 years but I quit a few years ago for my grandkids”.

Alcohol: Mary drinks 2-3 glasses of wine a week; “I like to have wine with dinner on Friday with my friends, maybe one or two more if we all have time”.

Social: Mary has dinner once a week with friends but spends most of time with the grand children; “I make sure to see my girl-friends on Fridays, but one of the granddaughters in a three year old and I end up watching her while her parents are at work.”

Medical History

Abdominal hysterectomy: Mary had a hysterectomy at age of 38; “I had a hysterectomy when I was 38”.

High blood pressure: Mary has high blood pressure but it has been well controlled for 8 years. Mary did improve her dietary habits in the past years moving away from fat-rich foods; “I was diagnosed with high blood pressure about 8 years ago, but since then I have changed my diet, which has kept it in check”.

Illicit drug use: Mary does not use drugs; “I have never been tempted to do illegal drugs.”

Family information

Siblings: Mary has no siblings; “I am an only child”.

Father: Mary’s father died of a heart attack at the age 70; “My father died a few years ago from a heart attack. I think he was 70”.

Mother: The mother is still alive (76 years old); “My mother is still alive and feisty at 76”.

Location: Mother resides in Florida but may move back to live with Mary and her husband; “My mother used to live in Florida but moved in with my husband and I”.

Husband: Mary lives with her husband, Jeff, to whom she has been married to for 32 years; “Me and my husband, Jeff, have been together for 32 years”. Jeff is a copyright lawyer; “My husband is a copyright lawyer”.

Children: Mary and her husband have 3 children, 2 girls (31 years old, 28 years old) and one boy (26 years old); “I was blessed with three kids, 2 lovely girls and a boy.”

Grandchildren: The two daughters both have kids of their own, who Mary babysits for 3 days a week (a 5-year old boy and 3-year old girl); “The girls both have a kid of their own, a boy (5) and a girl (3)”.

Appendix E: Confederate Instructions

Log on to “patient” AIM account. This can be done on a DL’ed AIM program. Do not use the Express version!

Patient Elliot: iuliucci.nicholas@gmail.com Password: Help12

Patient Mary: patient.mary Password Help12

Prior to Interviews

1. Once logged on check that the program is recording the conversations: File > preference > privacy > scroll to “Choose how your messages are saved” > check both boxes not already selected! This will save the conversations onto your computer called “AIM Logs”.
2. If you have not been informed of which patient you should be logged on to first contact Nick through his phone at 585-XXX-XXXX or use the AIM to message the contact named “nick”.
3. Make sure you have a watch/cellphone or other device that has a timer so you can track how long the PA student is talking to you.

During Interviews

As soon as you receive the first message from the PA student, start your timer! (first interview will always be 15 minutes and second will be 7 minutes).

Please send the PA student a reminder during the interview at 10 minutes for the 15 minute interview: “You have 5 minutes left for this interview” and at 5 minutes for the 7 minute interview: “You have 2 minutes left for this interview”

Once the time limit has run out, please say goodbye and end the conversation with

*****“please contact Nick for further instructions”.

Repeat these procedures for both interviews.

After Interviews

Go into your computer’s folders and open the one labeled “AIM Logs” this will have text files that are copies of the conversations with the PA students. There will be two main files that will be titled PA.student or similar to that. Send these files to nji7266@rit.edu.

Appendix F: Each Participant Checklist

Prior to contact:

1. Check that
 - (a) Confederate is online
 - i. Confirm that they know which patient to be logged on as first
 - ii. Have a timer ready
 - iii. There conversations have been set to auto record on AIM
 - (b) PA student AIM conversations have been cleared (do this between each participant)
2. Verify Participant Name and Year that is scheduled.

Upon contact from all participants:

1. Greetings: "Thank you for agreeing to participate in this study! My name is Nick, I will be mediating the study."
2. Confirm who they are & that they are scheduled for that time.
3. Questions (informed consent related):
 - (a) Have you read and signed the consent form?
 - (b) Do you have any questions regarding the informed consent form?

Pre-interviews

1. Please fill out demographic form.
2. Click link to demo Interviews
3. "Thank you for completing the demographic questionnaire. You will be interviewing two patients. Please try your best and treat these patients as you would a patient face to face. Contact me if you are having technical issues during the interviews."

4. Variation (follow steps on the related page number)

M E S L-p. 1

E M S L-p. 2

E M L S-p. 3

M E L S-p. 4

Variation–MESL**Mary-First Patient Interview Instructions:**

The first interview will be 15 minutes, starting from your first message to the patient. Please try your best and treat them as you would any other patient. The patient you will be consulting is named “Mary”, please contact them via IM.

1. Please Fill out Post Questionnaire “CSI (S)” — Click link CSI(S)
2. Please Fill out Post Questionnaire “P1” — Click link Q1

Elliot-2nd Patient Interview Instructions:

The next history interview will be 7 minutes, starting from your first message to the patient. Please try your best and treat them as you would any other patient. The patient you will be consulting is named “Elliot” please contact them via IM.

1. Please fill out Post Questionnaire “CSI (L)” — Click link CSI(L)
2. Please Fill out Post Questionnaire “Q2” — Click link Q2

Variation–EMSL

Elliot-First Patient Interview Instructions:

The next history interview will be 15 minutes, starting from your first message to the patient. Please try your best and treat them as you would any other patient. The patient you will be consulting is named “Elliot”, please contact them via IM.

1. Please Fill out Post Questionnaire “CSI (S)” —Click link CSI(S)
2. Please Fill out Post Questionnaire “P1” —Click link Q1

Mary-2nd Patient Interview Instructions:

The next history interview will be 7 minutes, starting from your first message to the patient. Please try your best and treat them as you would any other patient. The patient you will be consulting is named “Mary”, please contact them via IM.

1. Please fill out Post Questionnaire “CSI (L)” —Click link CSI(L)
2. Please Fill out Post Questionnaire “Q2” —Click link- Q2Ó

Variation–EMLS

Elliot-First Patient Interview Instructions:

The next history interview will be 15 minutes, starting from your first message to the patient. Please try your best and treat them as you would any other patient. The patient you will be consulting is named “Elliot”, please contact them via IM.

1. Please fill out Post Questionnaire “CSI (L)” —Click link CSI(L)
2. Please Fill out Post Questionnaire “P1” —Click link Q1

Mary-2nd Patient Interview Instructions:

The next history interview will be 7 minutes, starting from your first message to the patient. Please try your best and treat them as you would any other patient. The patient you will be consulting is named “Mary”, please contact them via IM.

1. Please Fill out Post Questionnaire “CSI (S)” —Click link- CSI(S)
2. Please Fill out Post Questionnaire “Q2” —Click link- Q2

Variation–MELS

Mary-First Patient Interview Instructions:

The next history interview will be 15 minutes, starting from your first message to the patient. Please try your best and treat them as you would any other patient. The patient you will be consulting is named “Mary”, please contact them via IM.

1. Please fill out Post Questionnaire “CSI (L)” — Click link CSI(L)
2. Please Fill out Post Questionnaire “P1” — Click link Q1

Elliot-2nd Patient Interview Instructions:

The next history interview will be 7 minutes, starting from your first message to the patient. Please try your best and treat them as you would any other patient. The patient you will be consulting is named “Elliot”, please contact them via IM.

1. Please Fill out Post Questionnaire “CSI (S)” — Click link CSI(S)
2. Please Fill out Post Questionnaire “Q2” — Click link Q2

Conclude:

Thank you again for your participation in this study. Do you have any questions regarding the study?

To ensure that the next participant (your fellow PAs) acts naturally and with the same information about the nature of the study as you did prior to participating, we ask that you do not discuss what you did during this study until after all data has been collected. This is to ensure the quality of the results and is critical.

Feel free to contact me if you have any other questions. To receive your compensation for participation, please return the signed consent form to the Department of Psychology office in room 01-2309 in the Eastman Building. If you are unable to pick up the compensation for any reason feel free to contact me and we can make arrangements.

Appendix G: Demographic Information Questionnaire[Edit this form](#)

Patient-Doctor Com Study- Demo

This form is just a few basic questions, once finished please follow the next step on your instruction sheet.

* Required

How old are you? (Years) *

What gender do you identify with? *

☐ Male

☐ Female

☐ Other:

Year in Physician Assistant Program *

☐ 1st

☐ 2nd

☐ 3rd

☐ 4th

☐ Alumni

Have you held any medical related position prior to entrance into PA program at RIT?

Please list any family members who worked in the medical field and their medical degree?

Have you done clinical rotations yet? *

☐ Yes

☐ No

If yes, which clinical rotations have you completed?

(write in order of most recent to least)

Please describe a typical interaction with a patient during these rotations?
(answer this question to the best of your ability)

How much time during rotations or job was spent with one-on-one diagnostic interaction with your patients? *

- ☐ 0-25%
- ☐ 26-50%
- ☐ 51-75%
- ☐ 76-100%

If you selected Alumni, how many years has it been since you graduated?

- ☐ 1-3 years
- ☐ 4-6 years
- ☐ 7-9 years
- ☐ 10+ years

If an Alumni, what is your specialty?

Submit

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Appendix H: First Post-Experiment Questionnaire

Patient-Doctor Com Study- Q1

This form is related to the patient that you have just finished interviewing. Please try your best and answer all questions to the best of your ability. Please answer the following questions without looking back at the conversation with the patient. Only use your notes and memory.

*** Required**

If forced to select a diagnosis for the just consulted patient, what would it be? *

Please explain your reasoning for this diagnosis? *

How confident are you in the diagnosis on a scale of 1 to 100? *

(1 = not at all, 100 = absolute confidence)

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Appendix I: Second Post-Experiment Questionnaire

Patient-Doctor Com Study- Q2

This form is related to the patient that you have just finished interviewing. Please try your best and answer all questions to the best of your ability. Please answer the following questions without looking back at the conversation with the patient. Only use your notes and memory.

* Required

If forced to select a diagnosis for the just consulted patient, what would it be? *

Please explain your reasoning for this diagnosis? *

How confident are you in the diagnosis on a scale of 1 to 100? *

(1 = not at all, 100 = absolute confidence)

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Patient-Doctor Com Study- Q2

* Required

Patient-Doctor Com Study- Q2 (Continued)

Have you had prior personal experience with these medical conditions;

Diabetes? *

- ☐ Yes
☐ N

If so explain:

Diverticulitis? *

- ☐ Yes
☐ No

If so explain:

« Back

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